



Montana Highway Economic Analysis Tool

User Manual (Draft)

prepared by

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1. Introduction

The Montana Department of Transportation (MDT) recently conducted a study of the economic effects of highway reconfiguration scenarios, namely adding highway capacity to major corridors. A major objective of the project is to develop a sophisticated methodology to compare and analyze the relative economic benefits of highway investment scenarios. A Geographic Information System (GIS) based model called the Highway Economic Analysis Tool (HEAT) has been developed to automate the process of economic impacts analysis under a single software program.¹ Through the development of HEAT, we are providing MDT with the in-house capability to analyze and quantify the relationship between highway capacity and economic development, and estimate the likely economic benefits and costs of potential highway improvements.

HEAT includes a custom toolbar, a user-friendly graphic interface, and a series of functions and tools focused at guiding planning staff through typical and repeatable processes to analyze and model the economic impacts of highway investment scenarios, assess existing industries, identify new and emerging industries, analyze freight and auto flows, and produce quantitative results for meaningful comparisons. GIS is the basis for HEAT to process data, explain concepts, present results, and implement analytical functions. Here is a list of the major modules and key functions of HEAT:

- (1) Scenario designation tools
 - Establish a highway scenario
 - Code project(s) and attributes of projects
- (2) Network analysis tools
 - Assignment routine
 - Accessibility analysis
 - User Benefits analysis
- (3) Economic analysis
 - Tourist spending effects
 - Business attraction (jobs)
 - Cost estimation
 - Economic growth by industry sector
 - Interface to REMI model
 - Benefit-cost analysis
- (4) User exploration tools
 - Map data
 - Desire lines (trip making patterns)

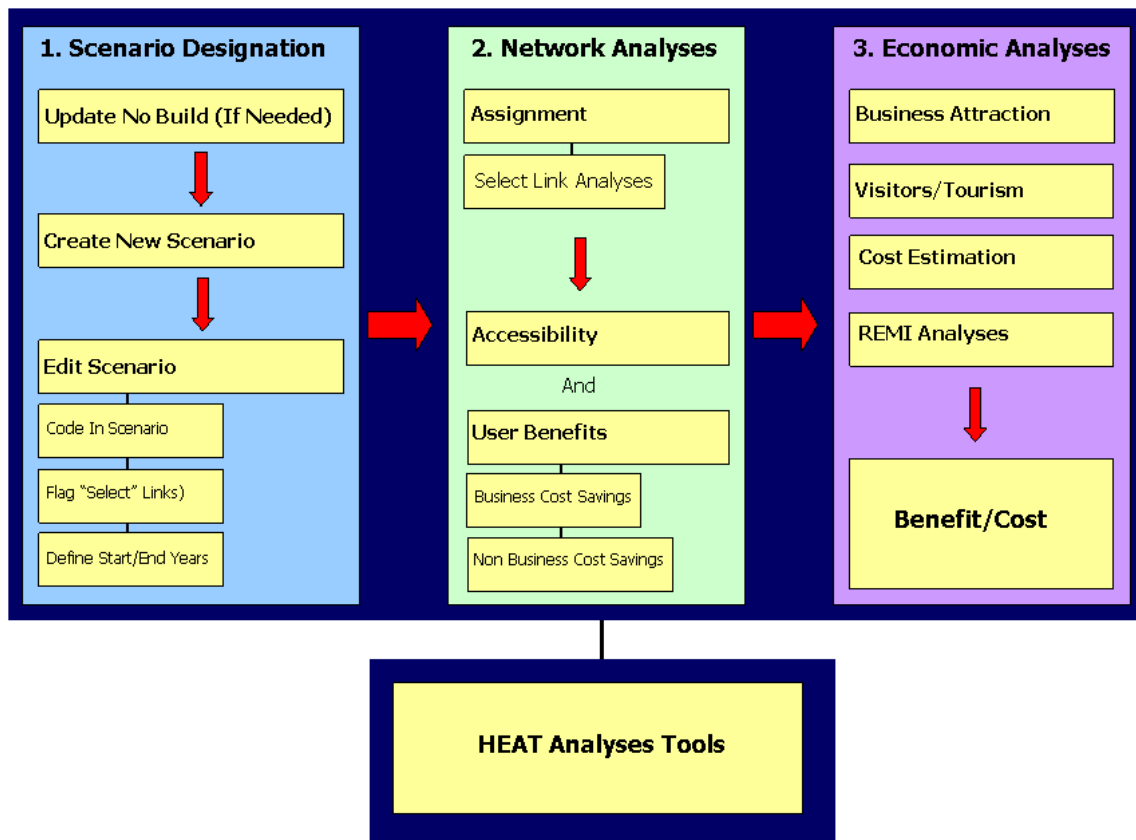
¹ Cambridge Systematics, Inc. is the primary developer of HEAT, with support from Economic Development Research Group, SEH, Inc., and ICF Consulting.

- Document library

HEAT was designed to automate the evaluation of economic impacts analysis. This user manual is designed to guide the user through all of the steps necessary to evaluate the economic impacts of highway investment scenarios in a consistent manner. The user can compare the results of any scenario with against the existing system (the “NOBUILD” scenario) as well as any other scenario.

This user manual deals primarily with the use of HEAT GIS tool itself. After checking for proper hardware and software compatibility in Section 2, the user should start with Section 3: Getting Started. Here the user will get a basic understanding of functionality, layout, and navigation in the GIS Tool. The user should then follow Sections 4 through 6, in order, to successfully build a scenario and analyze the economic impacts a desired scenario. Section 7 provides the guidance on using the exploration tools that provide more savvy methods for navigating within HEAT and viewing analysis results.

Montana HEAT Model



Extra Options - Not Necessary For HEAT Analysis

2. About HEAT

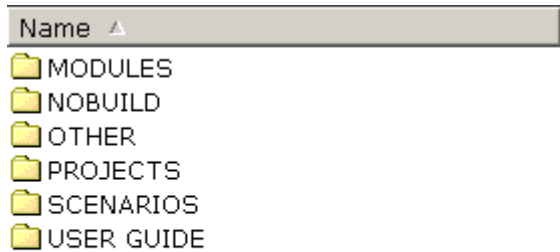
2.1 Development Environment

HEAT was developed using Visual Basic For Applications (VBA) in ArcGIS 9.3, the most recent ESRI desktop software release in the ArcGIS environment that is increasingly accessible to developers and users. Unlike other desktop GIS platforms of ESRI, ArcGIS is an object-oriented software. It is easy for customization as well as interfacing with other object-based software. It is also highly expandable because the tool can be built in modular format on an object-oriented platform. Developers can extend and expand the HEAT system without requiring any changes to the ArcObjects code. The only limitations on additional analyses or functions will come from the limitations of the parent platform (ESRI's ArcGIS 9.x) itself. MDT users may customize HEAT using ArcObjects or customized COM-objects via any of the programming languages supported by the parent platform (ESRI's ArcGIS 9.x), including VB, VBA, C++. In addition, some modules are run in ArcView 3.3, but are accessed through ArcGIS. The reasons for this will be discussed later.

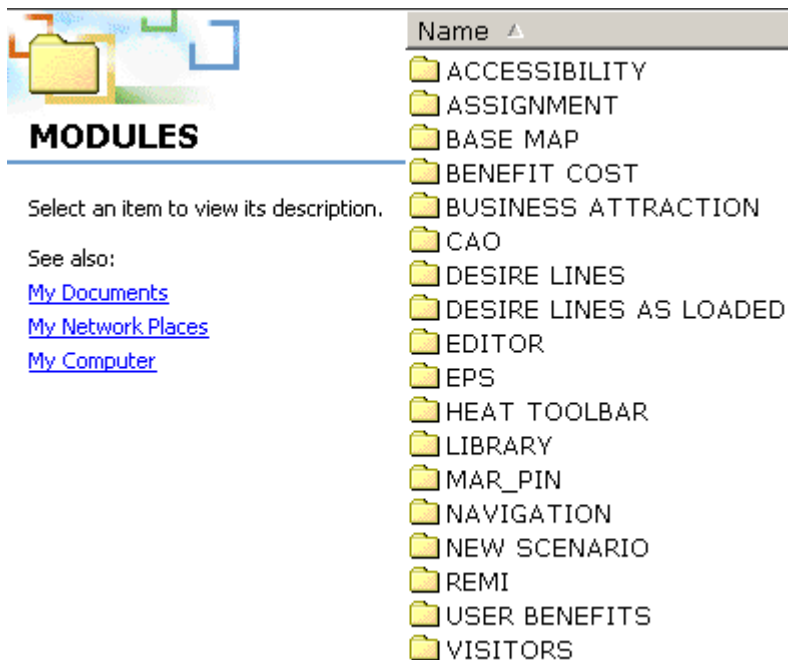
Since HEAT was originally developed, ArcGIS version 9 has become available and is currently supported by MDT. It's likely that HEAT will need to be updated eventually to this new version, and Cambridge Systematics will work with MDT to determine the optimal time to make this conversion.

2.2 Delivery Format

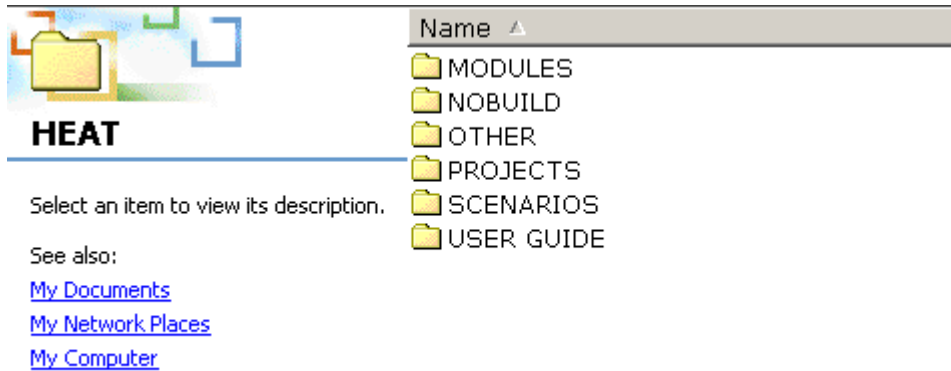
The GIS tool is built into an existing ArcGIS map document file ([HEAT ArcGIS.mxd](#)) which is stored in the Projects folder. Given the update to REMI, the ArcMap project needs to be run from the REMI folder (in this case “C:\mdtapps\REMI”) in order to call REMI. The GIS tools are built into an ArcMap map interface, which stores a map as an MXD map document.



The **MODULES** folder stores all of the files that are used in the tool. The subfolders here correspond to the various parts of the HEAT tool.



For the most part, the files that go with each module are stored in the appropriate folder, with some exceptions (Some spreadsheets need to be in the same folder for linkages).



The **NOBUILD** folder contains the Montana NoBuild network that is used as the basis for each HEAT Scenario. It is stored as a Geometric Network in ESRI's Geodatabase format. The NoBuild output shapefiles that are used for processing in some of the modules are also stored in this folder. A further description of the NoBuild network can be found on page 18.

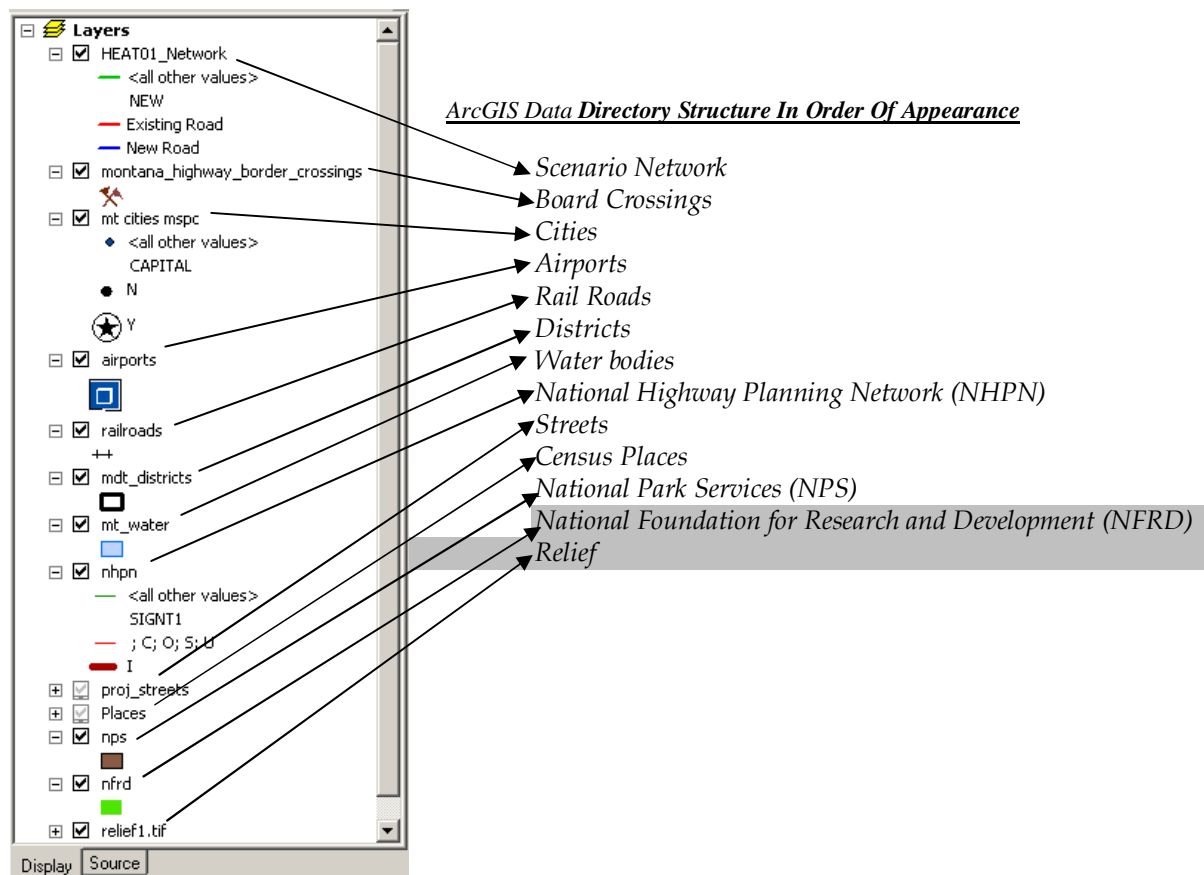
The **OTHER** folder simply contains any extra files and a back-up folder.

The **PROJECTS** folder is where any ArcGIS MXD HEAT backup projects can be stored.

The **SCENARIOS** folder stores the various scenario files for each scenario a user adds. All of the necessary spreadsheets, GIS and data files get stored here. Some of these files, like the Excel spreadsheets, are copied from **MODULES** subfolders when a scenario gets created. This helps to keep the data from each scenario from conflicting and keeps a complete record of information specific to each scenario.

2.3 Data Requirements

The figure below shows all the data items needed for HEAT. All GIS data in the personal geodatabase are projected to Montana State Plane NAD 83 coordinate system.



2.4 System Requirements

1. Hardware Requirements:

- A Pentium III PC, Minimum 450 MHz processing speed
- Minimum 128 MB RAM
- Minimum 500 MB hard disk space. Minimum 50 MB on the operating system drive and an additional 100 MB hard disk space are required
- CD-ROM drive or networked CD-ROM drive (650 MB HDD space recommended)

2. Software Requirements:

- Windows NT , Windows 2000 or Windows XP operating system
- ESRI ArcGIS 9 (multiple license or single license version)
- ESRI ArcView 3.3
- Network Analyst for ArcView 3.3
- Microsoft Excel Version 2002

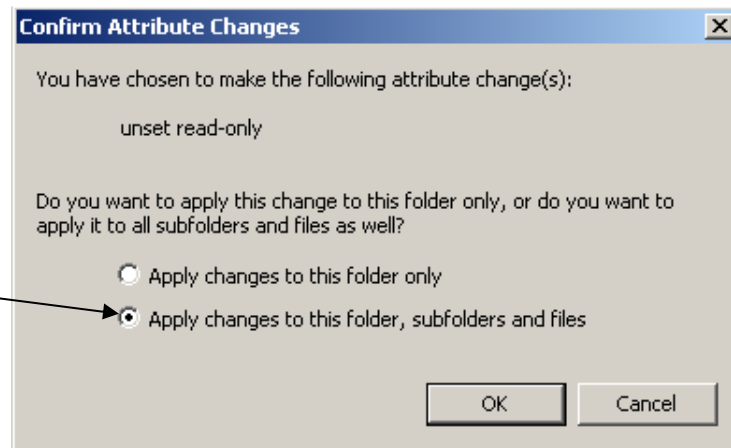
2.5 Software Installation

The GIS software and the supporting data should reside locally on the hard drive of the user's computer. The user should have writing permission to the computer drive where the supporting geodatabase resides. To install the software and supporting database:

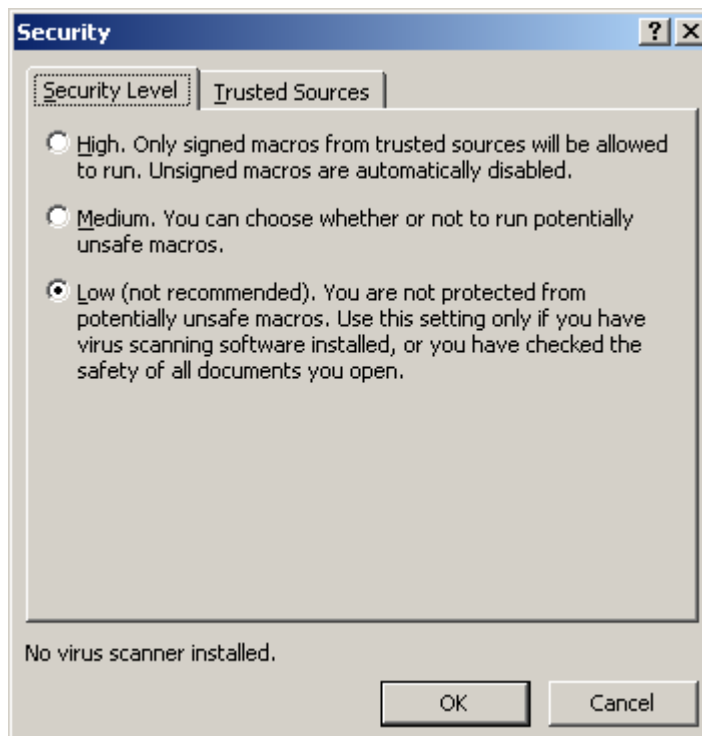
1. Insert the CD with the HEAT GIS Tool in your computer's CD-ROM drive.
2. Copy the HEAT folder in the CD to "C:\mdtdata"
3. Right click the folder on your local computer and click on **Properties**. Under "Attributes", verify that "Read-only" is not checked. If it is checked, uncheck the "Read-only" box , click **Apply** and then click **OK**. Otherwise, click **OK**.

4. A confirmation message will ask whether you want to apply the changes to this folder and all subfolders and files. Check the option “Apply changes to this folder, subfolders and files”, and click **OK**.

Check this option to unset the read-only attribute of all subfolders and files



5. In order to run REMI 7 from ArcGIS, you need to go to the **C:\mdtdata\HEAT\PROJECTS** folder and copy the HEAT project (HEAT_ArcGIS9.mxd) to the **C:\mdtapps\REMI** folder and run it from there.
6. Set the security settings in **MS Excel** to medium or low in order for them to be populated.



3. Getting Started

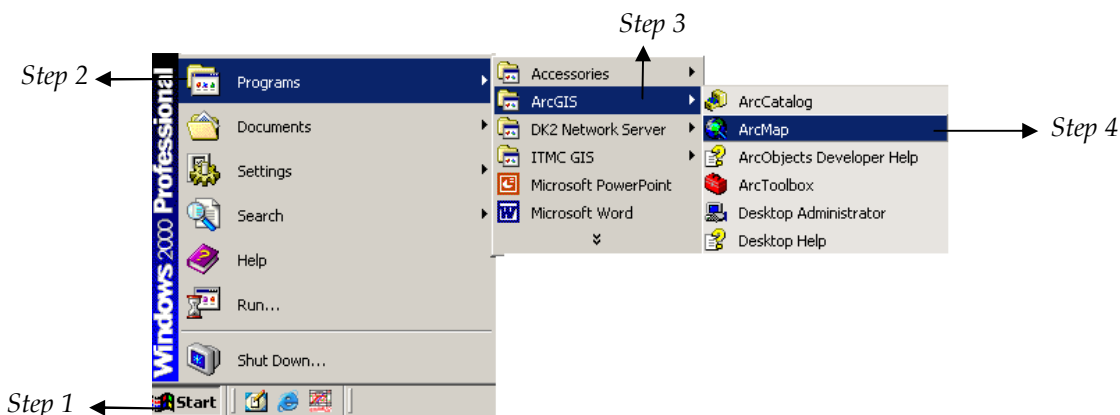
After installing the HEAT GIS Tool on the local computer, it is recommended that the user start by following the instructions in this section, which give a basic overview of the use, navigation, and functionality of the software.

3.1 Starting ArcMap

ArcGIS desktop consists of three core applications: ArcMap, ArcCatalog, and ArcToolbox. ArcMap is the map interface that can be used for all mapping and editing tasks, as well as map-based analysis. HEAT is built into a map document (HEAT01.mxd) that can be opened in ArcMap.

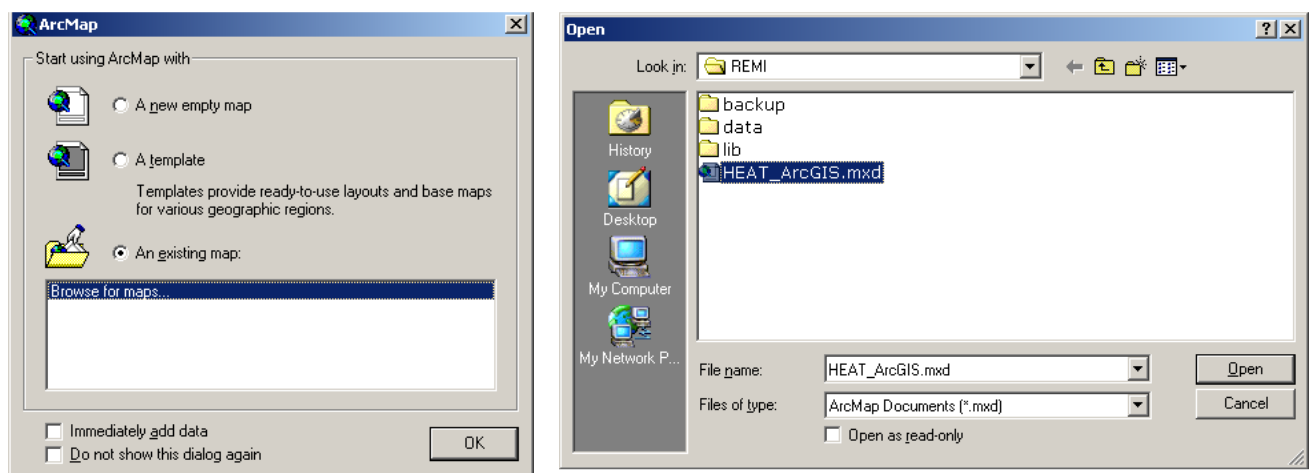
The design of the GIS tool assumes its users have a basic knowledge of ArcMap. If further help is needed on how to use ArcMap, users are recommended to use the ArcMap help menu or refer to the ArcMap User Guide (*Using ArcMap*, ESRI, 2000).

1. Click the **Start** button on the Windows taskbar, as shown in Figure 3.1.
2. Point to **Programs**.
3. Point to **ArcGIS**.
4. Click **ArcMap** to start the ArcMap application.



The first time you start ArcMap, the Startup dialog box appears with three options for how to start your ArcMap session: a new empty map, a template, or an existing map (Figure 3.2). Check the option of an existing map.

5. Double click **Browser for maps**.
6. In the dialog box, click the dropdown arrow and navigate to the map folder on the local drive where you installed the files for the HEAT GIS tool (C:\mtdtdata\HEAT\HEAT_ArcGIS.mxd).
7. Double click HEAT_ArcGIS.mxd and open the map document

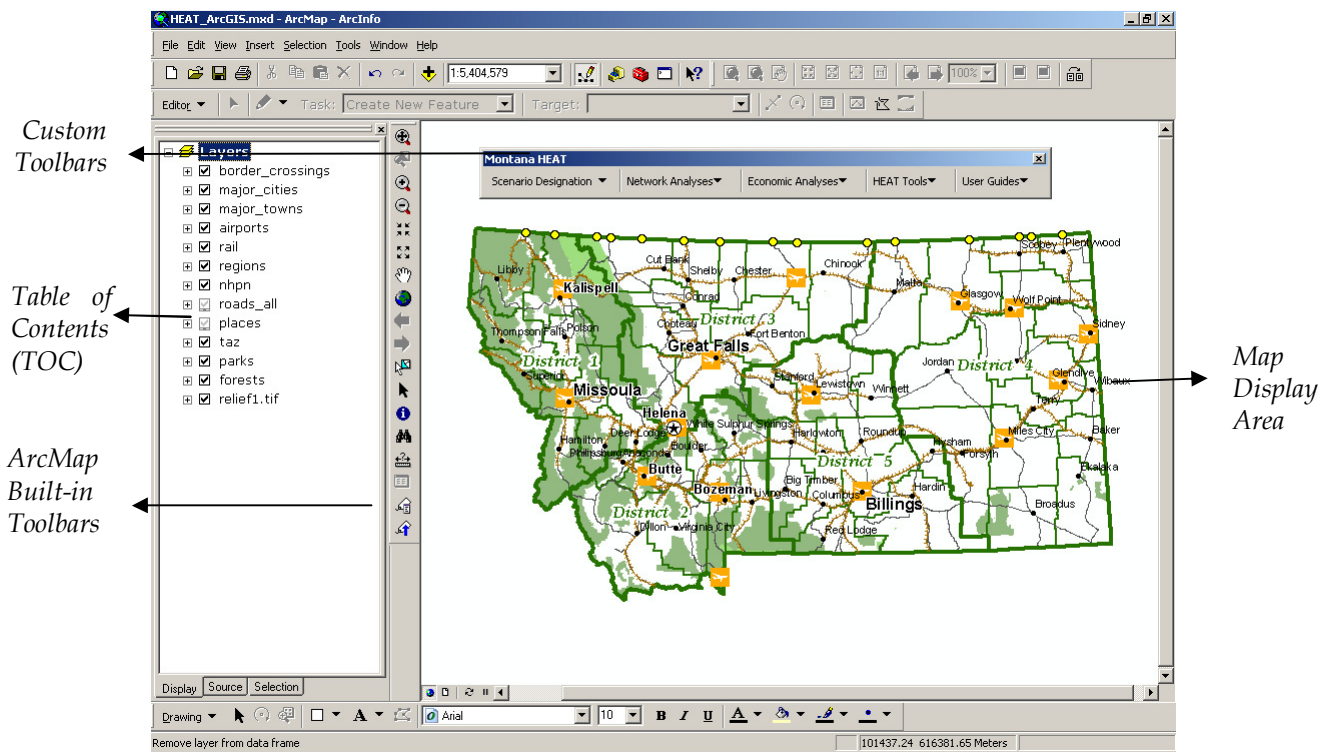


In addition, there are back-ups of the above MXD project saved to C:\mtdtdata\HEAT\PROJECTS\HEAT Backup Projects.

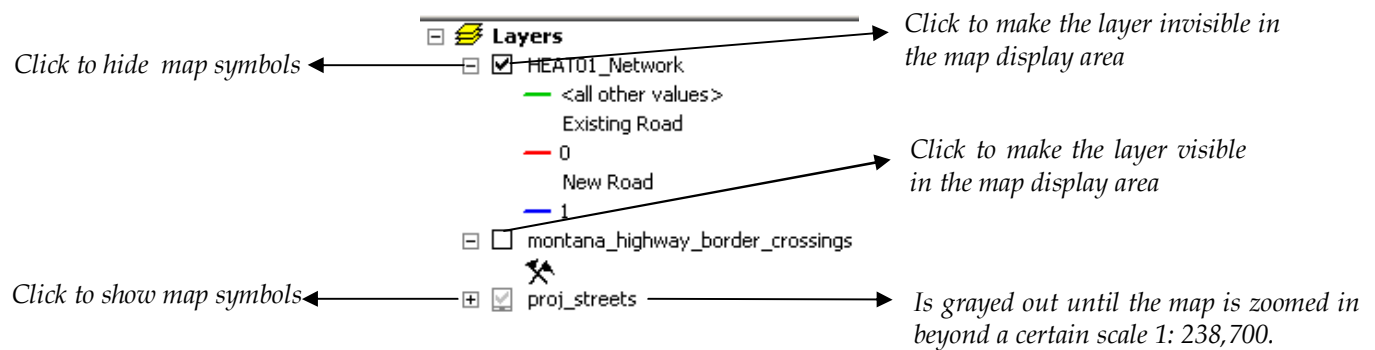
Name	Size	Type
Backup		File Folder
HEAT_ArcGIS9.mxd	3,323 KB	ESRI ArcMap Do...
reg_1.1	14 KB	1 File
reg_2.2	14 KB	2 File
reg_3.3	14 KB	3 File
reg_4.4	14 KB	4 File
reg_5.5	14 KB	5 File
schema.ini	1 KB	Text Document
userbens_results_heat.txt	6 KB	Text Document

3.2 Map Interface

The figure below shows the appearance of the map document HEAT01.mxd, after being opened in ArcMap. The map interface includes the following sections: (1) Table of Contents, (2) Map Display Area, (3) ArcMap Built-In Toolbars and (4) Custom Built Toolbars built specially for the GIS decision support tool. ArcMap Built-In Toolbars are explained further in Section 3.3, and Custom Built Toolbars are explained in Section 3.4.

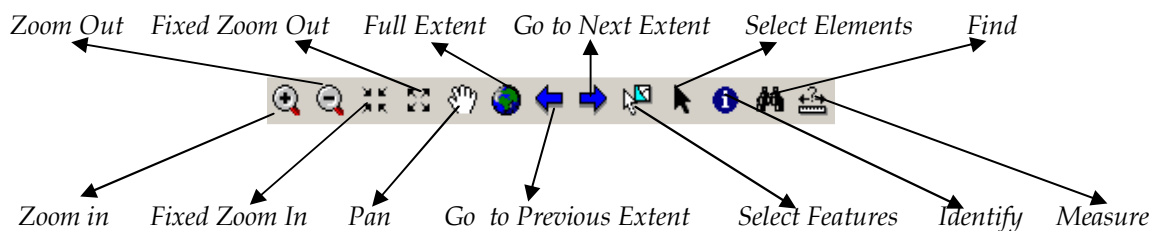


On the right hand side of the map interface is the Map Display Area where visible maps are shown. To the left is the Table of Contents, showing all the map layers that are available for display. There is a toggle switch and a checkbox in front of each map layer. You can click on the toggle switch to make map symbols shown or collapsed on the Table of Contents. A minus sign means the map symbols are hidden, while a plus sign means the map symbols are shown. The check box is used to turn on and off the visibility of each map layer. An empty checkbox means the map is not shown in the map display area, while a check in the checkbox means the map is shown. The checkbox for the street layer (proj_streets) and census place layer (Places) are grayed out, meaning these map layers are set to be visible beyond a certain map scale.



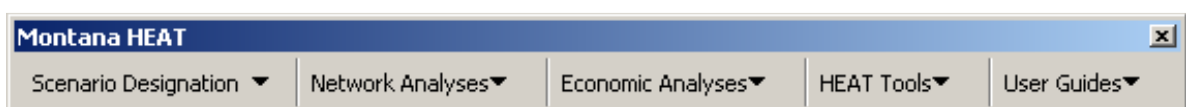
3.3 ArcMap Built-In Toolbars

ArcMap has built-in tools that let you move around the map freely and query the features on the map. Place your pointer over each icon to see the description of each tool and click on the icon to use the tool. Use the ArcMap help menu or refer to the ArcMap User Guide (*Using ArcMap*, ESRI, 2000) for further help on how to use these built-in tools.



3.4 Custom Built Toolbars

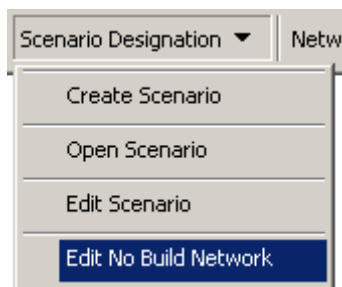
The decision support GIS tool is built into the ArcMap interface as a set of custom toolbars containing a series of functions and tools focused on guiding planning staff through typical and repeatable travel demand and economic analysis based planning processes. The custom toolbar has the following four key modules: (1) a Scenario Designation Module, (2) a Network Analysis module, (3) an Economic Analysis module and (4) HEAT Supporting GIS tools.



1. **Scenario Designation.** This section of the tool is the starting point for HEAT. A new highway investment scenario can be created or an existing scenario opened and edited to designate the scenario in the network. There is also the option to edit the NOBUILD network.
2. **Network Analyses.** This is the part of the tool that runs the traffic assignment, select link analysis, accessibility and user benefits for the scenario network. If the NOBUILD was changed, these components need to be re-run for the NOBUILD, in addition to the investment scenario.
3. **Economic Analyses.** This step represents the final part of the scenario analysis. The visitors/tourism model, business attraction, construction cost estimation, REMI analysis and finally the benefit/cost analysis of the project.
4. **HEAT Tools.** These tools are not directly connected to the HEAT scenario analysis, but provide a means by which to gain some background information to help with the process. The base map layers can be added or removed, the user can navigate by city or county, commodity flows can be viewed through the desire lines tool, and the HEAT library provides industrial profiles, tourism data and county-level industry data.
5. **User Guides.** This menu contains links to the user manuals.

4. Scenario Designation

4.1 Edit NOBUILD Network

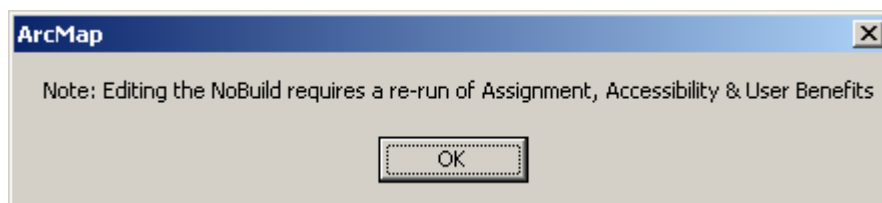


Purpose:

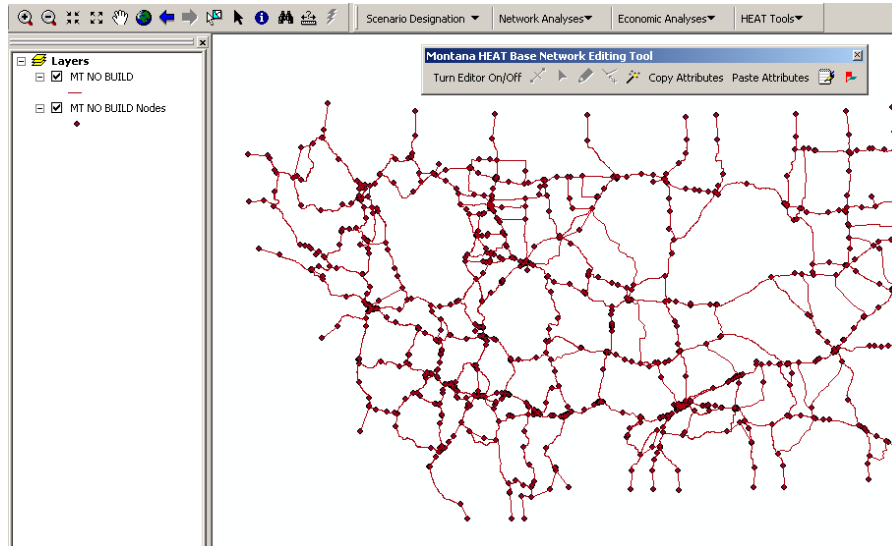
The NOBUILD should only be edited if the base network needs to be changed for a highway investment scenario. The NOBUILD was recently updated to capture highway segments with “pre-World War II” standards. If the NOBUILD is edited, the Network Assignment, needs to be re-run for it.

Process:

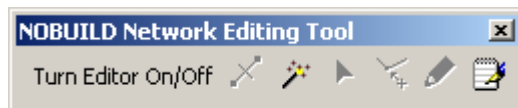
1. Click the arrow to the right of **Scenario Designation**, and click **Edit NOBUILD Network**. A warning message will appear.



2. The NOBUILD Network and Nodes are added to the map and the editing toolbar appears.



3. The NOBUILD Toolbar has the following buttons (Listed left to right).



- Turn Editor On/Off – This turns on the editor. The ArcInfo license needs to be activated. The Editor is turned on when the standard ESRI editing tools to the left are not grayed out.
- Split Line Tool – A standard ArcMap tool which allows a selected link to be split. Only one can be split at a time. Attributes besides length are copied.
- View Centroid Connectors – This button toggles between showing and not showing the centroid connector links for the network. Centroid connectors should not be edited.
- Select Line – A standard ArcMap tool that selects a feature. Here it is used to select a part or parts of the network. Hold down the shift key to select more than one at a time.
- Set Snap Tolerance – Use this tool to set the snap tolerance for new links which are added to the network. Select the tool and pull it out on the map to draw a circle which represents how close features need to be to be “snapped” or connected to the network. It is important that any new roads

are snapped to the network, because any gaps will cause incorrect results in the assignment.



- Add New Feature – A standard ArcMap tool that allows for the drawing of a new highway link in the network.
- Update Attributes – This opens a dialog which lets the user view the attributes most important for running a scenario, as well as the tools needed to update and code in the NOBUILD attributes.

The screenshot shows the 'No Build Attributes Manager' dialog box. It has a title bar with a close button. The dialog is divided into several sections:

- Select The Field To Update:** A list box containing attributes: ACCESS TYPE (DIVUNDIV), AREA TYPE (AT_), FUNCTIONAL CLASS (FC), NUMBER OF LANES (LANES), PAVEMENT CONDITION (PAVEMENT), ROAD NAME (FIRST_NAME), TERRAIN TYPE (TERRAIN), and TYPE 2 LANES (TYPE2). An annotation box labeled 'Select the attribute' points to this list.
- Select A Value:** A text input field. An annotation box labeled 'Select the value' points to this field.
- Type In Value:** Another text input field.
- Attribute Values For Selected Link:** A table showing current values for the selected attribute.
- Update NoBuild Attribute Data:** A button at the bottom. An annotation box labeled 'This will change the value selected in the No Build.' points to this button.
- Color Codes:** A legend box on the right side of the dialog.

The table in the 'Attribute Values For Selected Link' section is as follows:

FIELD ALIAS	VALUE DESCRIPTION
PAVEMENT CONDITION	Paved
FUNCTIONAL CLASS	Rural Minor Arterial
AREA TYPE	Rural Area
TERRAIN TYPE	Mountainous
NUMBER OF LANES	2 Lanes
ACCESS TYPE	Undivided
TYPE 2 LANES	PRE WW
ROAD NAME	STRAIN
SEGMENT LENGTH	25.82 mi
SPEED	44 mph
CAPACITY	24970
TRAVEL TIME	35.2090909 minutes

The 'Color Codes' legend is as follows:

- Output/Descriptive Value
- User Defined Value
- Default Value
- Incorrect/No Value

An annotation box labeled 'Changes will be reflected over here' points to the table.

4.2 Create Scenario

Purpose:

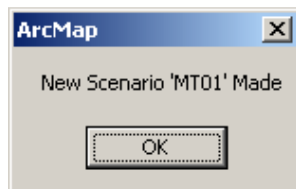
A new scenario first needs to be created to start the HEAT analysis. Starting a new scenario creates a new folder in the SCENARIOS directory and necessary files are copied to this new folder from the MODULES directory. The NOBUILD Geodatabase gets copied to the scenario folder, and this copy becomes the scenario network. (Note: if the NOBUILD has been edited, you must close and restart ArcMap, because of a locking issue with the Geodatabase)

Process:

1. Click the arrow to the right of **Scenario Designation**, and click **Create Scenario**. A dialog will appear.



2. Choose a name for the scenario and hit Enter. A message will appear after it is complete. (Note: Avoid using spaces in the name if possible, though this shouldn't cause problems.)



4.3 Open Scenario & Edit Scenario

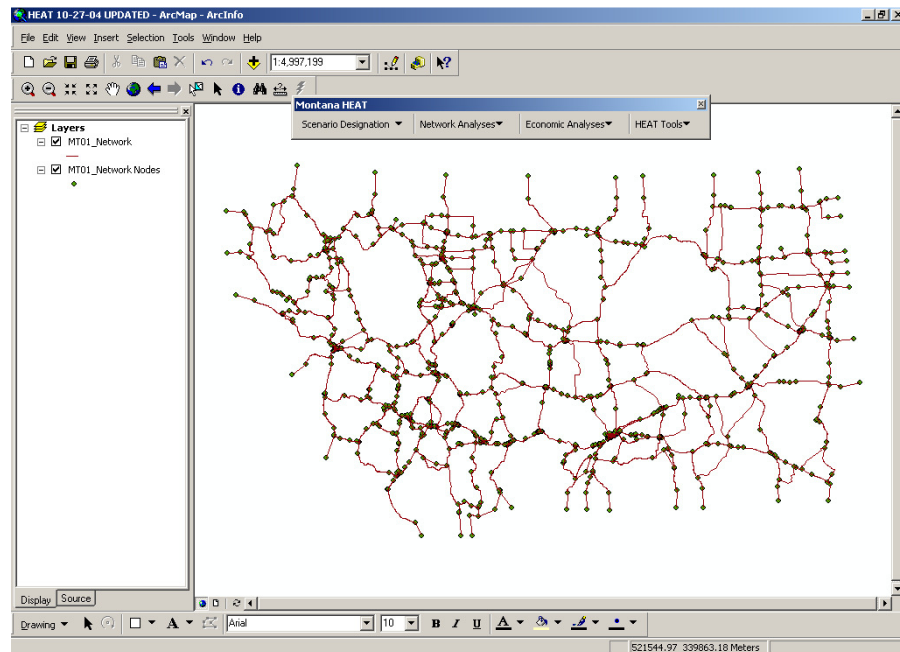
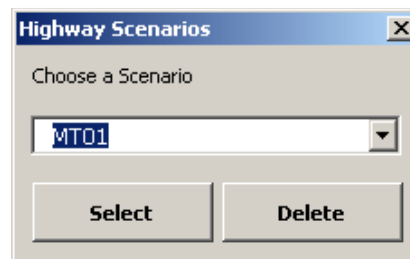
Purpose:

Once a scenario has been created, it needs to be added to the map so that the editing can take place.

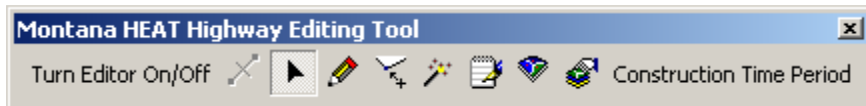
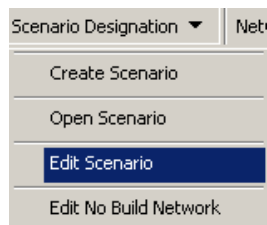
Process:

Note: The letters in bold represent necessary steps

1. **Choose** Scenario Designation>Open Scenario and then find the scenario you wish to edit. Hit **Select** to add it to the map or **Delete** to remove it permanently.



- When you open a scenario, the link to the scenario folder path gets stored in this file "C:\mdtdata\HEAT\SCENARIOS\THEPATH.TXT".
- The scenario links and nodes are added to the map (Note: in this example, the base map layers are removed). The nodes show the endpoints of each roadway. These help you to see exactly where the roadway segments are split and they are typically split due to different attributes. If you wish to not view the nodes, uncheck them in the Table of Contents (TOC) on the left hand side.
- Open the Scenario Editing toolbar.



- Refer to Section 4.1 to see how tools to the left of the "Update Attributes" button work.
- Update Attributes (Scenario) – This opens a dialog which lets the user view the attributes most important for running a scenario, as well as the tools needed to update and code in the Scenario attributes.



Select the attribute

Select the value

Changes will be reflected over here

Toggles between coding a Select Link

Cambridge S

Scenario Attributes Manager

Select The Field To Update

Attribute Values For Selected Link

FIELD ALIAS	VALUE DESCRIPTION
PAVEMENT CONDITION	Paved
FUNCTIONAL CLASS	Rural Major Arterial
AREA TYPE	Rural Area
TERRAIN TYPE	Rolling/Hills
NUMBER OF LANES	4 Lanes
ACCESS TYPE	Undivided
TYPE 2 LANES	IMPROVED2
ROAD NAME	US HWY 191
SEGMENT LENGTH	3.09 miles
OVERRIDE SPEED	0 mph
NEW ROAD	No
SELECT LINK	No
SPEED	64 mph
CAPACITY	82080
TRAVEL TIME	2.896875 minutes
IN SCENARIO	Yes

Update Data and Put Segment in Scenario

Choose Select Link

Add/Remove From Scenario

User Defined Value

Default Value

Incorrect/No Value

This will change
the value selected
in the Scenario



- a. Update Value and Code as Scenario – This button will update a selected link with the value that is chosen for an attribute in the above list boxes.
- b. Add/Remove Link From Scenario – This toggles between the selected link being coded as part of the scenario or not.
- c. Flag Select Link – For each scenario, a Select Link must be chosen for the Select Link analysis which happens automatically during the assignment. The user should choose a “representative” link from which origin-destination patterns will be determined.
- d. Run Speed Calculations – This allows for the updating of speed, capacity and travel time, without having to update attributes.



- Road Classifications – This button will let you color the scenario roads based on Scenario Roads, New Roads, Centroid Connectors, No Speed Calcs, or No Category (All roads the same symbol).



- Select Scenario – This button selects all of the roads in the scenario.
- Construction Time Period – For each scenario, a start and end year need to be defined for the estimated construction time period. These years are used throughout the rest of the HEAT analysis.

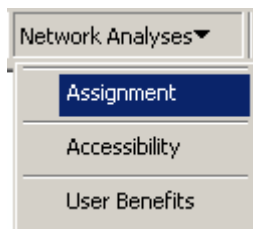
5. Network Analysis

5.1 Assignment

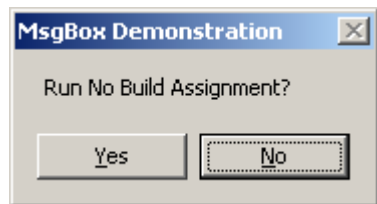
Purpose:

The purpose of the Assignment procedure is to assign traffic volumes to the scenario and NOBUILD highway networks based on an origin-destination (OD) table. The assignment uses an “all or nothing” approach, which means that the shortest path from origin to destination is always used, regardless of the volumes on the roadways (a reasonable assumption for most uncongested roads). Any time the NOBUILD and scenario highway attributes are updated, this must be re-run.

Process:

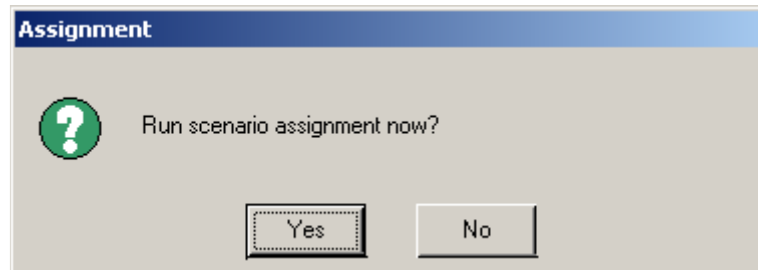


1. Click the arrow to the right of **Network Analysis**, and click **Assignment**. A message will appear.

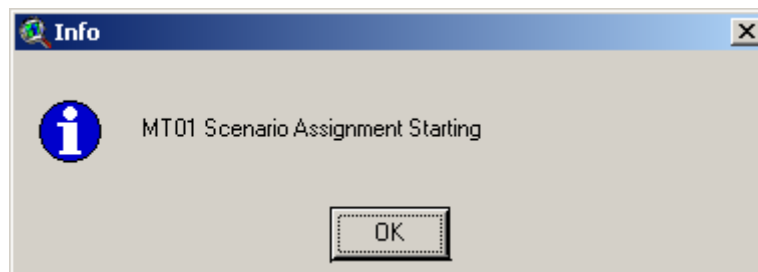


2. If the NoBuild has been changed, then you must run it, otherwise “No” should be the default. **If you select “Yes” to run the NoBuild, then once that has finished running, you must then run the assignment again and click “No” to run the scenario assignment.**

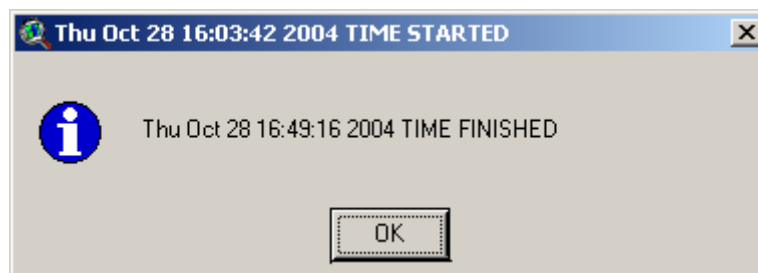
- Due to restrictions in the Network Analyst for ArcGIS, ArcView 3.3 is used to run the assignment. An ArcView 3.3 project will open which contains scripts which run the assignment and select link analysis. A message box appears when the ArcView 3.3 assignment project opens. (Note: Make sure that the Network Analyst Extension is activated in the APR project)



- Since the assignment can run anywhere from 40 minutes to over an hour, this option to cancel the assignment was added in case it was started by accident.
- If "Yes" is selected a confirmation dialog which gives the name of the scenario appears. Hit "OK" and the assignment will run.



- Once the assignment is finished, the following message box will appear.



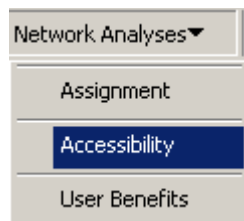
5.2 Accessibility

Purpose:

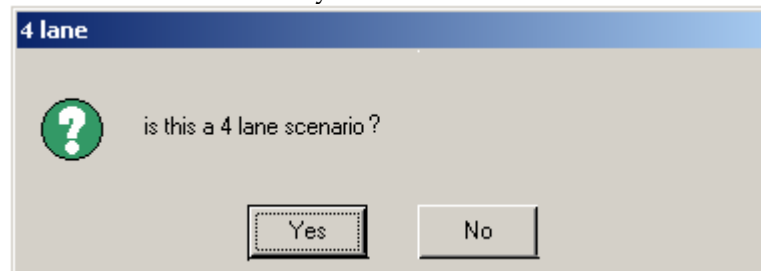
The purpose of the Accessibility analysis is to determine the changes in travel times from each HEAT Zone (County) centroid to various facilities and markets. These facilities and markets include Large Cities, Airports, Border Crossings, Grain Elevators, etc. Changes in accessibility are inputs to the business attraction analysis module.

Process:

1. After the Assignment has been run, choose Accessibility under the Network Analysis category.



2. Once again, limitations within the ArcGIS Network Analyst prompted the use of ArcView 3.3 for this procedure. Travel time polygons get created for the scenario and NOBUILD networks and stored in the respective folders.
3. When it is finished, this message appears. This should only be selected if the majority of the scenario is 4 lanes, and it's a function that ties into the business attraction analysis.



The results can be viewed in the "accessresults.dbf", which is located in HEAT/SCENARIOS & the current scenario folder.

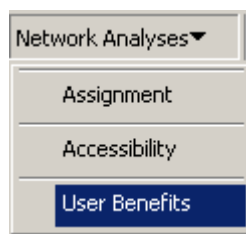
5.3 User Benefits

Purpose:

The purpose of User Benefits is to determine the various differences in monetary terms from the NOBUILD and the Scenario for travel time, operating costs, accidents, and reliability. These are the categories of user benefits, which are further defined by trucks, business auto trips, and non-business auto trips.

Process:

1. After the assignment has been run, choose User Benefits under the Network Analysis category.



2. A dialog appears

A screenshot of the 'User Benefits Results' dialog box. The dialog has a title bar with 'User Benefits Results' and a close button. Below the title bar, there is a text field containing 'aa1'. To the right of this field are three buttons: 'Run User Benefits', 'Save UB Results', and 'Import UB Results'. Below these buttons is a large empty rectangular area. Below this area is a row of tabs: 'Total Benefits', 'Travel Time', 'Fuel', 'Non-Fuel', 'Travel Reliability', 'Fatalities', 'Injuries', 'PDOs', 'HC', 'CO', 'NO', and 'CO2'. The 'Total Benefits' tab is selected. Below the tabs is a large empty rectangular area. At the bottom of the dialog, there is a section titled 'Inputs to Business Cost Savings'. This section contains several input fields and buttons. On the left, there are fields for 'Daily truck inputs:', 'Total Annual truck inputs:', and 'Annualization Factor:' (with a value of 280). In the center, there are fields for 'Daily Business auto inputs:', 'Annual Business auto inputs:', and a 'Re-calculate' button. On the right, there are fields for 'Daily Non-Business auto inputs:', 'Annual Non-Business auto inputs:', and buttons for 'Run Business Cost Savings' and 'Run Non-Business Cost Savings'. Below this section is another section titled 'Annual VHT Statistics'. This section contains fields for 'NoBuild Truck VHT:', 'Scenario Truck VHT:', 'Truck VHT Savings:', 'NoBuild Auto VHT:', 'Scenario Auto VHT:', and 'Auto VHT Savings:'. To the right of these fields is an 'Export Summary' button.

- Since the files need to be processed in ArcView 3.3 for the Assignment, when this dialog is opened, the scenario Geometric network is switched with the NOBUILD and scenario shapefiles in ArcMap. (Note: Sometimes an error occurs in re-loading the Geometric network – if so, just re-open the scenario)
- The first thing to do is choose “Run User Benefits” button. The process will take a few minutes to run. You will see a blue status bar in the upper right-hand part of the dialog which lets you know how far along the process is.
- When it is finished it should appear as shown below, with values for the various outputs populated.

User Benefits Results [X]

TCP090806

Save UB Results Import UB Results

USER_BENEFITS finished

Total Benefits	Travel Time	Fuel	Non-Fuel	Travel Reliability	Fatalities	Injuries	PDOs	HC	CO	NO	CO2
	Total	All Trucks	Autos	Non-Freight Tr...	Agricultural Pr...	Mining Product					
NOBUILD	\$23,222,084.33	\$13,477,721.75	\$9,744,362.58	\$2,256,068.37	\$664,428.98	\$87,016.40					
Alternative	\$22,794,237.87	\$13,327,510.36	\$9,466,727.51	\$2,213,025.53	\$657,180.31	\$86,191.81					
Difference	\$427,846.46	\$150,211.39	\$277,635.07	\$43,042.84	\$7,248.67	\$824.59					

Inputs to Business Cost Savings

Daily truck inputs: \$130,148.98 Daily Business auto inputs: \$34,865.80 Daily Non-Business auto inputs: \$173,911.44

Total Annual truck inputs: \$36,441,714.40 Annual Business auto inputs: \$9,762,424.00 Annual Non-Business auto inputs: \$48,695,203.20

Annualization Factor: 280

Re-calculate Run Business Cost Savings Run Non-Business Cost Savings

Annual VHT Statistics

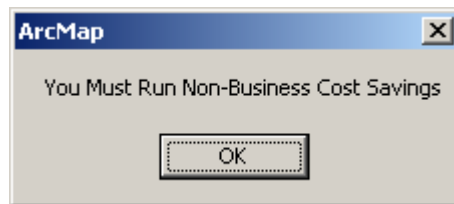
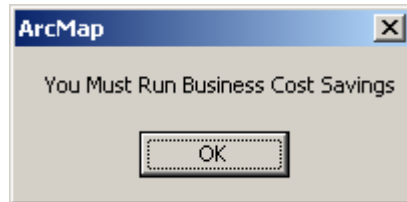
NoBuild Truck VHT: 48,806,770.00 NoBuild Auto VHT: 90,674,648.55

Scenario Truck VHT: 48,247,695.87 Scenario Auto VHT: 88,279,492.09

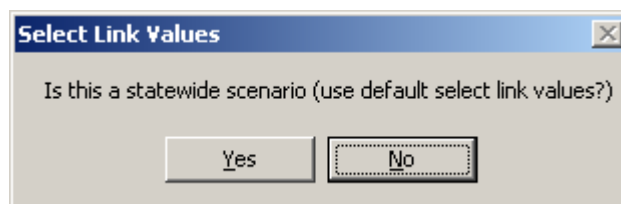
Truck VHT Savings: 559,074.13 Auto VHT Savings: 2,395,156.46

Export Summary

6. Once the results are shown, the **Save UB Results** button should be clicked. The results are saved to a text file in the scenario folder. This way, next time this dialog box is opened, you can use **Import UB Results** to load the results in without having to re-run it.
7. Before the dialog box is closed, both the **Run Business Cost Savings** and **Run Non-Business Cost Savings** need to be run. These provide inputs for REMI and the benefit-cost analysis, and you will get a message box reminding you if you did not run them.



8. When you click **Run Business Cost Savings** you will get a message which asks you if the scenario is statewide and if default select link values should be used. If you have projects that are spread throughout the state in a scenario, you should click yes to represent origin-destination patterns for the entire state. For corridor studies, you should not click yes, and instead should pick a representative highway segment for the select link analysis.



The select link analysis helps you get information on the OD flows for the scenario. To view this information, you can open the "userbenefits_remi_inputs.xls" spreadsheet. This spreadsheet is located in HEAT/SCENARIOS & the current scenario folder. The numbers for each of the Regions can be viewed in **businessautobenefits** and **truckbenefits** sheets.

14								
15								
16								
17				business auto benefit			\$535,689	
18	REMI Employment			0.0172	0.0592	0.0738	0.052	0.7796
19	REMI 3	REMI 4	REMI 5	REMI 1	REMI 2	REMI 3	REMI 4	REMI 5
20	1.483	0.942	2.063	\$9,214	\$31,713	\$39,534	\$27,856	\$417,623
21	3.614	1.183	4.063	\$9,214	\$31,713	\$39,534	\$27,856	\$417,623
22	1.797	1.972	1.097	\$9,214	\$31,713	\$39,534	\$27,856	\$417,623
23	8.443	3.613	7.573	\$9,214	\$31,713	\$39,534	\$27,856	\$417,623
24	6.833	4.02	7.484	\$9,214	\$31,713	\$39,534	\$27,856	\$417,623
25	17.799	7.933	9.122	\$9,214	\$31,713	\$39,534	\$27,856	\$417,623
26	37.022	15.786	31.161	\$9,214	\$31,713	\$39,534	\$27,856	\$417,623
27	4.284	1.67	6.794	\$9,214	\$31,713	\$39,534	\$27,856	\$417,623
28	71.097	28.839	60.382	\$9,214	\$31,713	\$39,534	\$27,856	\$417,623
29	4.596	3.187	6.124	\$9,214	\$31,713	\$39,534	\$27,856	\$417,623
30	156.968	69.145	135.863	\$92,139	\$317,128	\$395,338	\$278,558	\$4,176,231
31								
32								
33								

businessautobenefits truckbenefits auto by vmt truck by VMT REMI inputs final REMI inputs

Draw AutoShapes

- businessautobenefits spreadsheet

10																			
11																			
12																			
13																			
14																			
15																			
16																			
17																			
18	Truck TSAs							trucking benefit											
19	REMI 2	REMI 3	REMI 4	REMI 5	truck services	own-account		pertruckben_R1	pertruckben_R2	pertruckben_R3	pertruckben_R4	pertruckben_R5							
20	2.962	0.963	0.53	1.363	0.01391	0.00681	334182.85920	25258.00680	1126409.95710	924831.63360	1986153.65010								
21	0.896	1.053	0.334	1.373	0.01791	0.00603	334182.85920	25258.00680	1126409.95710	924831.63360	1986153.65010								
22	0.592	0.473	0.614	0.601	0.00721	0.02306	334182.85920	25258.00680	1126409.95710	924831.63360	1986153.65010								
23	1.126	1.2	0.493	1.061	0.01513	0.05589	334182.85920	25258.00680	1126409.95710	924831.63360	1986153.65010								
24	1.321	1.965	1.347	2.075	0.05021	0.00061	334182.85920	25258.00680	1126409.95710	924831.63360	1986153.65010								
25	3.353	5.203	2.554	3.234	0.00295	0.00059	334182.85920	25258.00680	1126409.95710	924831.63360	1986153.65010								
26	2.162	2.485	1.054	2.107	0.00439	0.03728	334182.85920	25258.00680	1126409.95710	924831.63360	1986153.65010								
27	0.859	1.225	0.467	1.959	0.00386	0.03816	334182.85920	25258.00680	1126409.95710	924831.63360	1986153.65010								
28	3.946	4.959	2.042	4.322	0.00392	0.01753	334182.85920	25258.00680	1126409.95710	924831.63360	1986153.65010								
29	0.108	0.104	0.08	0.147	0.00852	0.06065	334182.85920	25258.00680	1126409.95710	924831.63360	1986153.65010								
30	17.325	19.630	9.515	18.242	0.12800	0.24660													
31																			
32																			

businessautobenefits truckbenefits auto by vmt truck by VMT REMI inputs final REMI inputs

Draw AutoShapes

- truckbenefits spreadsheet

6. Economic Analysis

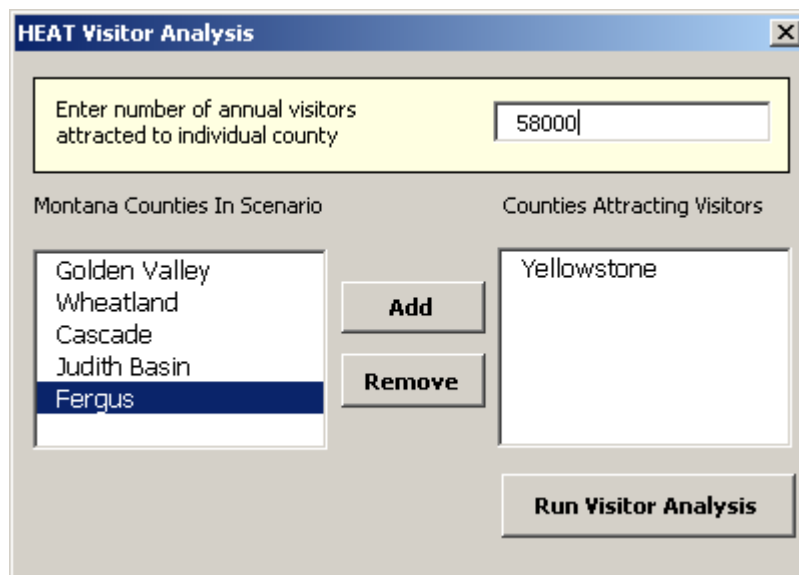
6.1 Visitors/Tourism Model

Purpose:

This step is an optional analysis module designed to be used when a highway improvement is likely to result in increased tourism. The module allows users to enter in the number of new visitors that are expected to be attracted to each county due to a highway investment scenario.

Process:

1. From the Economic Analysis menu, choose Visitors/Tourism model. The Excel spreadsheet will open in front of ArcMap. Minimize Excel to view the dialog shown below.

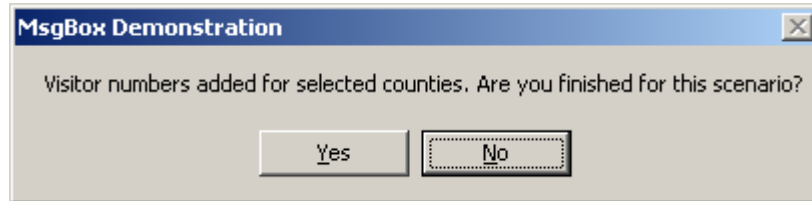


The dialog box is titled "HEAT Visitor Analysis". It features a text input field at the top labeled "Enter number of annual visitors attracted to individual county" with the value "58000" entered. Below this, there are two list boxes. The left list box, titled "Montana Counties In Scenario", contains the following counties: Golden Valley, Wheatland, Cascade, Judith Basin, and Fergus (which is currently selected). The right list box, titled "Counties Attracting Visitors", contains the county "Yellowstone". Between the two list boxes are "Add" and "Remove" buttons. At the bottom right of the dialog is a "Run Visitor Analysis" button.

2. Choose a county and add it into the right-hand list. Enter the number of visitors at the top and then click "Run Visitor Analysis". The counties listed are the ones that have highway improvements. This will populate the

spreadsheet for each county selected. If more than one county appears in the right list box, all will be given the amount of visitors entered at top.

- When you are finished, hit “Yes” on the message box that appears below.



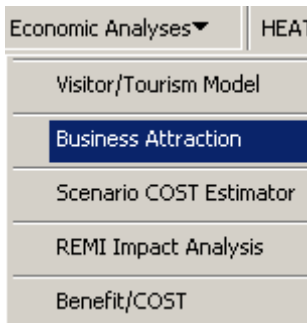
To view this information, you can open the “visitor_remi_inputs.xls” spreadsheet. This spreadsheet is located in HEAT/SCENARIOS & the current scenario folder.

6.2 Business Attraction

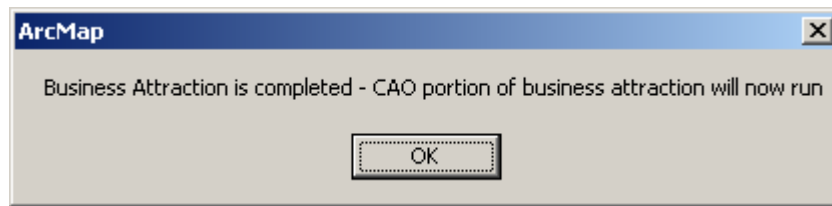
Purpose:

The purpose of the business attraction analysis is to estimate industry by industry job impacts due to increased accessibility to markets, people, airports, border crossings, and intermodal rail terminals. This is an additional business effect from more traditional transportation cost measures, and captures both industry competitiveness characteristics (i.e., growth trends, costs, etc.) as well as the transportation reliance of each industry.

Process:



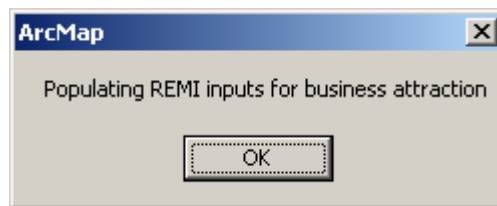
- Under Economic Analysis, go to Business Attraction. There is no user interface, as the process runs behind the scenes. After a few moments, this message will appear and you can hit “OK”.



2. It takes a few seconds to run and you will be informed at the bottom-left part of the screen as to what is taking place. Pay close attention to these messages so that the process isn't exited prematurely.

STAND BY FOR BUSINESS ATTRACTION TO FINISH...

3. REMI inputs get populated at this point. This message signals that the process is over and you can move on to the next step.



To view the business attraction information, you can open the "business_attraction_remi_inputs.xls" spreadsheet. This spreadsheet is located in HEAT/SCENARIOS & the current scenario folder. The "CAOCALCS" sheet contains the information by REMI Region.

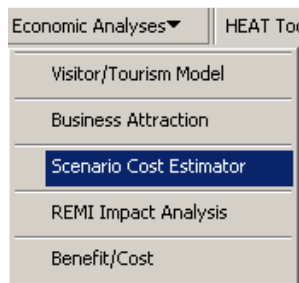
6.3 Scenario Cost Estimator

Purpose:

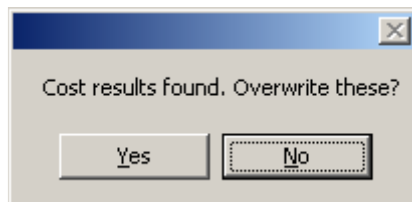
The Cost module is intended to calculate the costs of the highway investment scenario. Each of the links in the scenario is grouped by attribute category and run through the cost spreadsheet. For example, if 100 miles of roads are all coded as level/plains, 2 lanes, Improved 2, these 100 miles will represent one run in the cost module. Depending on the different kinds of attributes present, it may need to run several times.

Process:

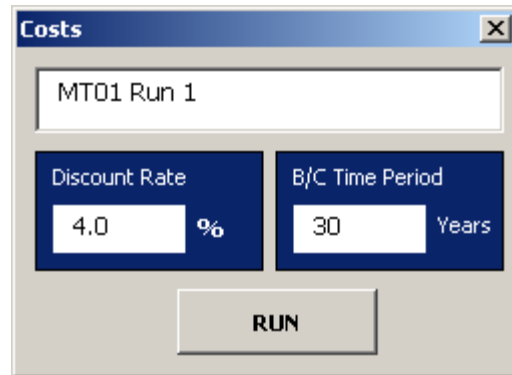
1. Under **Economic Analysis**, choose the **Scenario Cost Estimator** sub-category.



2. If Cost results are found, this message will appear. If not, the module dialog box will open automatically.



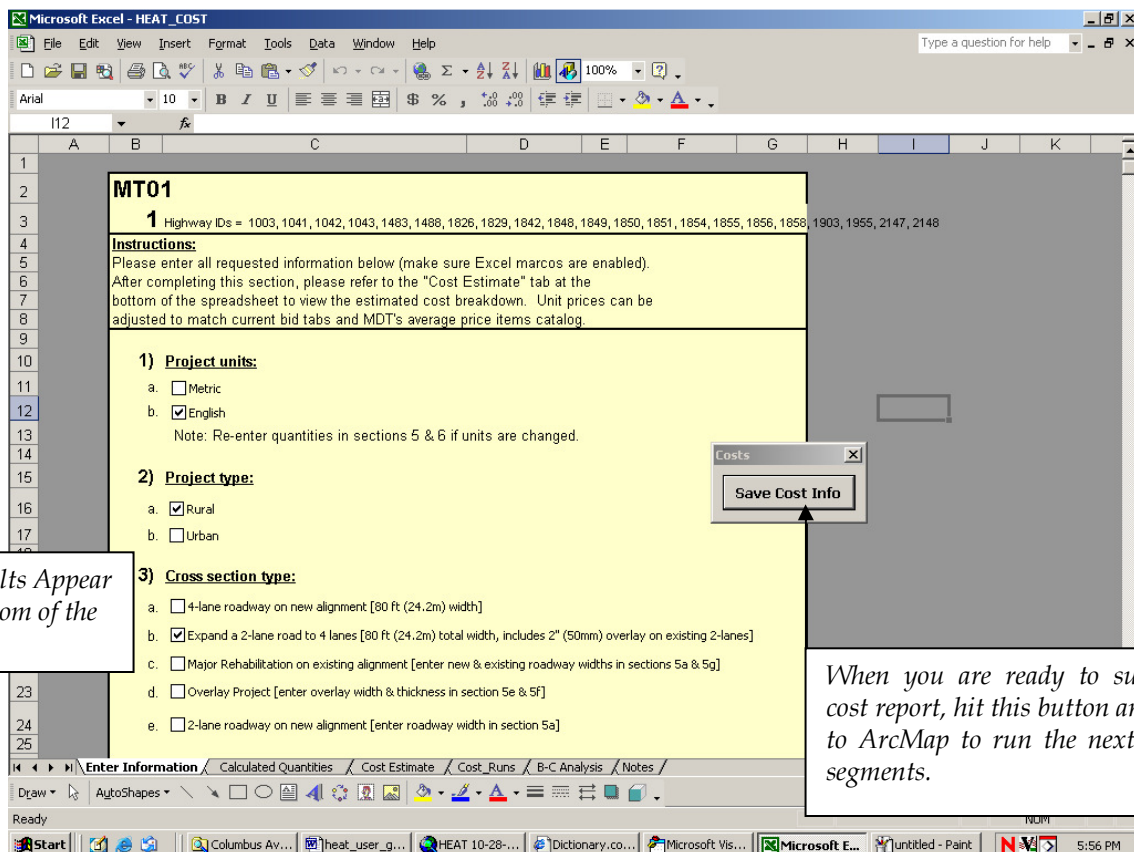
3. This dialog box will appear first when the Cost module is run. You can adjust the **Discount Rate & Benefit/Cost Time Period** accordingly.



A dialog box titled "Costs" with a close button (X) in the top right corner. It contains a text field with "MT01 Run 1". Below this are two input fields: "Discount Rate" with "4.0" and a "%" symbol, and "B/C Time Period" with "30" and "Years". At the bottom is a "RUN" button.

4. Hit run to open the Excel Cost spreadsheet and begin the cost runs.

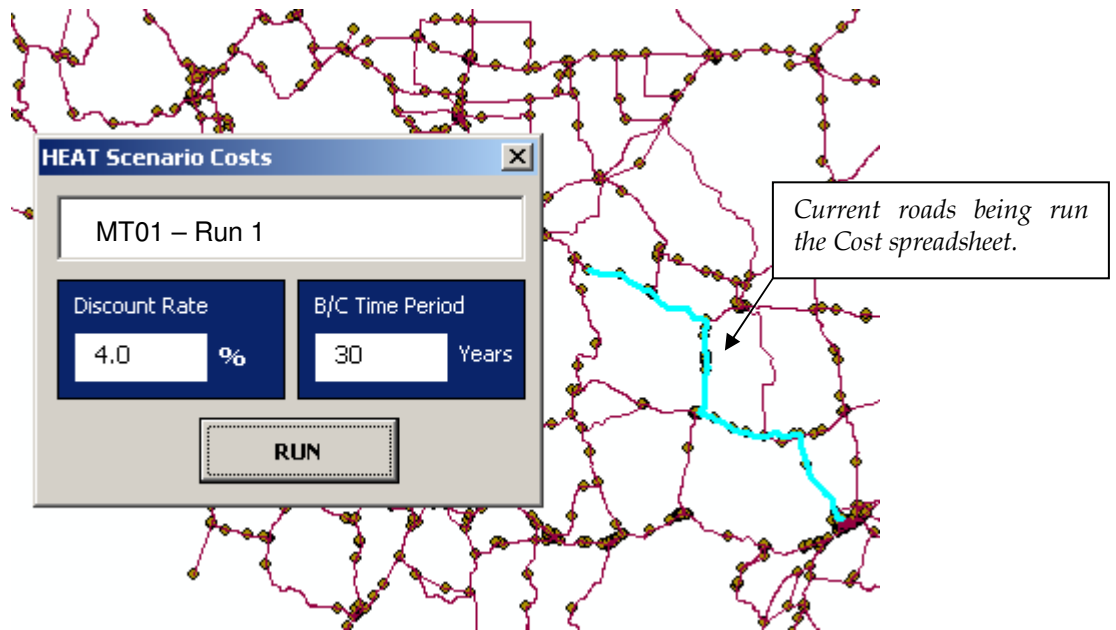
The Heat Cost Spreadsheet



A screenshot of the Microsoft Excel spreadsheet titled "HEAT_COST". The spreadsheet is divided into several sections. The first section is "MT01" with a list of Highway IDs. The second section is "Instructions" with a paragraph of text. The third section is "1) Project units:" with checkboxes for "Metric" and "English" (checked). The fourth section is "2) Project type:" with checkboxes for "Rural" (checked) and "Urban". The fifth section is "3) Cross section type:" with checkboxes for "4-lane roadway on new alignment", "Expand a 2-lane road to 4 lanes" (checked), "Major Rehabilitation on existing alignment", "Overlay Project", and "2-lane roadway on new alignment". A "Costs" dialog box is open over the spreadsheet, showing a "Save Cost Info" button. A callout box points to the "Save Cost Info" button with the text: "When you are ready to submit this cost report, hit this button and go back to ArcMap to run the next round of segments." Another callout box points to the bottom of the spreadsheet with the text: "Cost Results Appear at the bottom of the page". The spreadsheet has tabs at the bottom: "Enter Information", "Calculated Quantities", "Cost Estimate", "Cost_Runs", "B-C Analysis", and "Notes". The "Enter Information" tab is selected.

5. If not already open, click on the "Enter Information" tab, scroll up and down review the inputs to make sure everything is correct. The default values should do for most analyses, but some scenarios may require specific adjustments. When you are ready, hit the "Save Cost Info" button.

6. Next go back into ArcMap and hit run in the open dialog box.



7. The next group of segments for the scenario will be highlighted as shown above so you can see which roads the cost module is being run on.
8. Repeat this process for each of the road segments with the same attributes. When it is finished, this box will appear. If you close it, the cost process will end and the cost info will be stored in the scenario folder. The Total Cost of Construction represents the capital cost in undiscounted terms for the construction period. The PV of Costs represents the present value of discounted costs over the full life of the highway project, including long-term operating and maintenance costs and is used in the benefit-cost analysis.

HEAT COST RESULTS	
Total Cost of Construction:	\$599,291,448.23
PV of Costs:	\$614,661,355.90

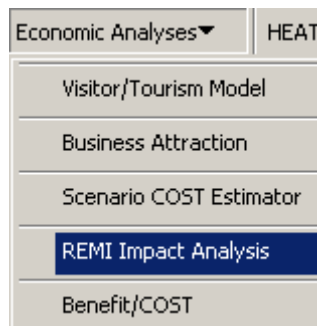
6.4 REMI Impact Analysis

Purpose:

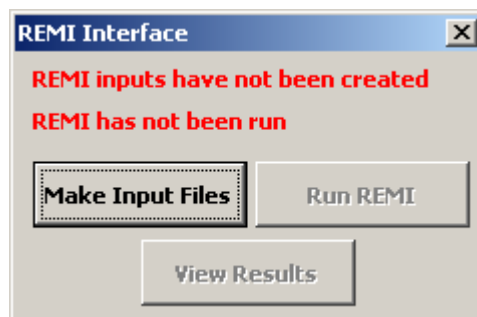
REMI (Regional Economic Models, Inc.) provides a way to analyze the total economic effects by region based on inputs provided. The modules that have been run thus far all contribute to these inputs and these are automatically added to REMI and run through the ArcMap interface.

Process:

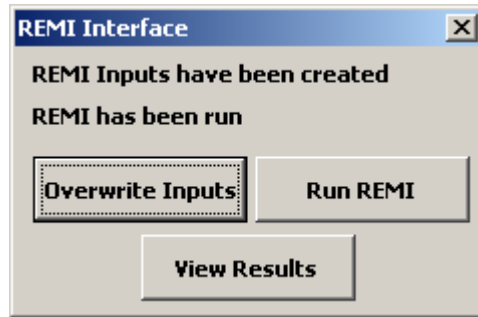
1. Under Economic Analysis, choose the REMI Impact Analysis sub-category.



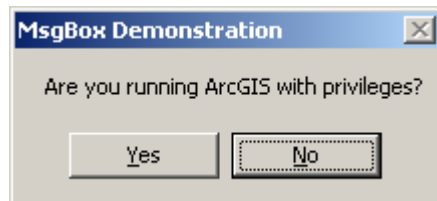
2. If REMI has not been run, you will see this box appear.



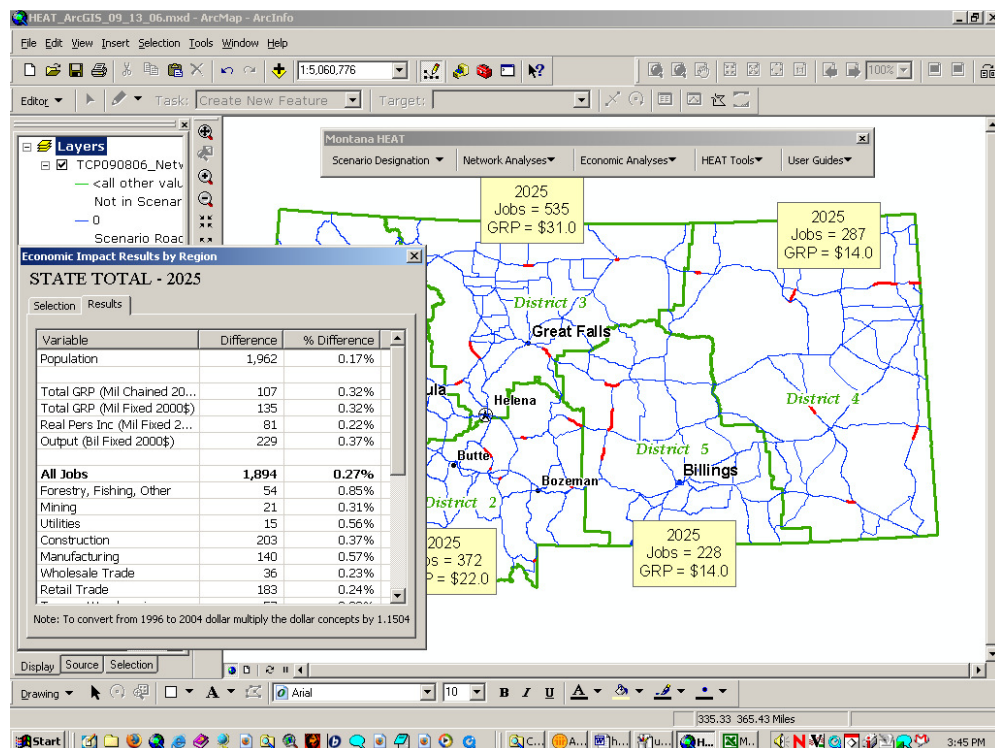
3. Choose make input files to process the text files from the Input spreadsheets which will be used as the basis of the REMI runs for each region. **Note:** Make sure Excel is open before making input files.
4. You can choose to run REMI now or close the dialog and run it later.
5. If you re-open the dialog, it will appear as follows.



6. If you haven't yet run REMI, hit the "Run REMI" button and REMI will start and the input files (in CSV format) will be automatically added in. When it's done, REMI will close and 5 new text files will be produced (REMIdata.1, REMIdata.2, etc...), one for each District.
7. Just say yes to the following message(This is something internal to MT DOT)



8. When you choose "View Results", the REMI output spreadsheet opens and is summarized in a dialog box which opens in ArcMap. Minimize the spreadsheet to view the dialog.



9. As shown above, select the “Results” tab to view the Regional Impact Results differences for each of the 5 regions (aka Districts) of the state totals. Labels showing regional summaries are also added to the map.

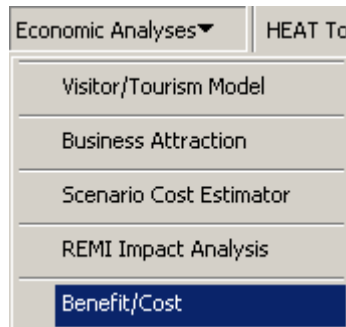
6.5 Benefit/Cost Analysis

Purpose:

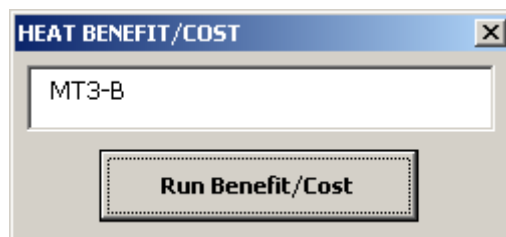
This represents the final step in the HEAT scenario analysis. The Benefit/Cost module prepares the Benefit/Cost spreadsheet that takes inputs from the Cost spreadsheet as well as the REMI spreadsheet and others to come to a final Benefit/Cost ratio for the scenario.

Process:

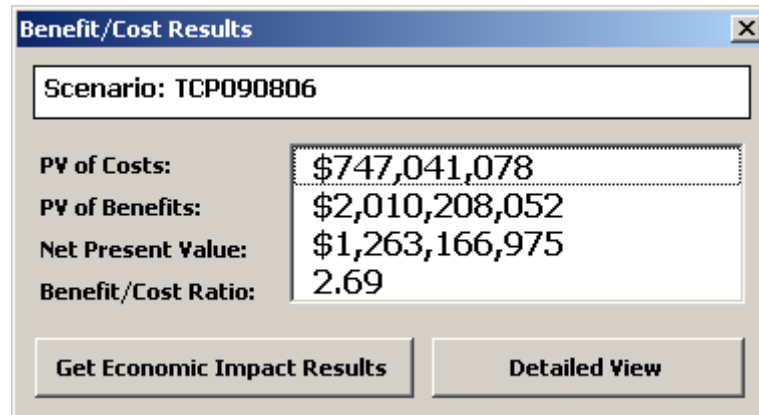
1. Under Economic Analysis, choose the Benefit/Cost sub-category.



2. If Benefit/Cost has not been run, a dialog will be shown to run B/C, the B/C spreadsheet will open and the numbers will be populated.



- Once Benefit/Cost has finished, the summary dialog will display as shown below. The Benefit/Cost Excel spreadsheet will also open, and you can view that for more detailed information (HEAT_BENEFIT_COST.xls).

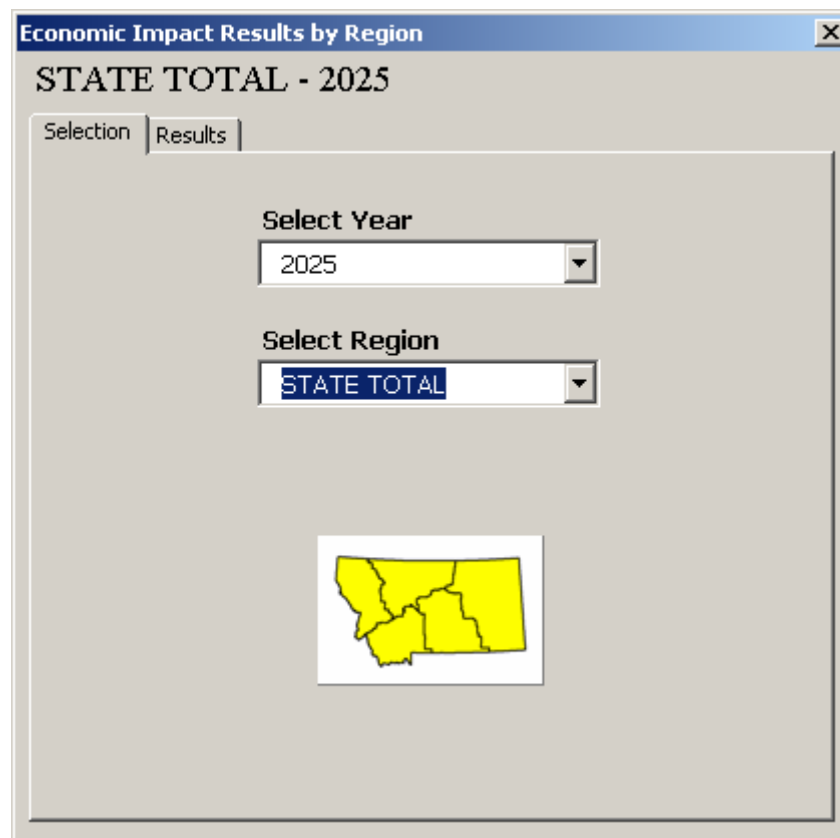


The "Benefit/Cost Results" dialog box displays the following information:

Scenario: TCP090806	
PV of Costs:	\$747,041,078
PV of Benefits:	\$2,010,208,052
Net Present Value:	\$1,263,166,975
Benefit/Cost Ratio:	2.69

Buttons: Get Economic Impact Results, Detailed View

- If you click the "Get Economic Impact Results by Region" button, the same dialog that comes up after the REMI results are finished is shown here as well.



The "Economic Impact Results by Region" dialog box displays the following information:

STATE TOTAL - 2025

Selection Results

Select Year: 2025

Select Region: STATE TOTAL

Map of Montana showing regional divisions.

To view the Benefit/Cost information, you can open the “HEAT_BENEFIT_COST.xls” spreadsheet. This spreadsheet is located in HEAT/SCENARIOS & the current scenario folder.

7. HEAT Tools

Heat tools are a collection of reference modules that are not directly connected to the HEAT scenario analysis, but provide useful background information on mapping, commodity flow data, industry profiles, and tourism data.

7.1 Add/Remove Base Map Layers

Purpose:

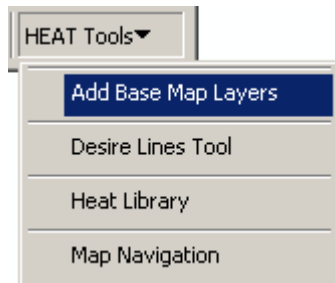
The purpose of the Add/Remove Base Map Layer tool is to add certain map layers to ArcGIS , including the following:

- Boarder Crossings
- Major Cities
- Airports
- Railroads
- Districts
- Water Boundaries
- National Highway Planning Network (NHPN)
- Streets
- Places
- Parks
- Forests
- Relief

Add/Remove Base Map Layer tool will enable you to add these base maps to the map view using predefined symbols and scales.

Process:

1. Click the arrow to the right of **HEAT Tools** on the Custom Built Toolbar and Click **Add Base Map Layer**.



- a. If the base maps are not loaded to the MXD file, it will load all base map layers and add them to the Table of Contents (TOC) and map view.
- b. If the base maps are already loaded to the MXD file, it will remove all base map layers from the TOC and map view.

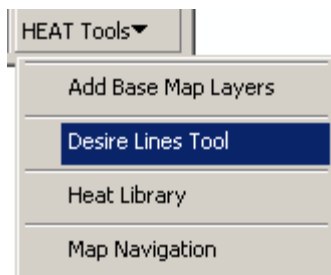
7.2 Desire Lines Tool

Purpose:

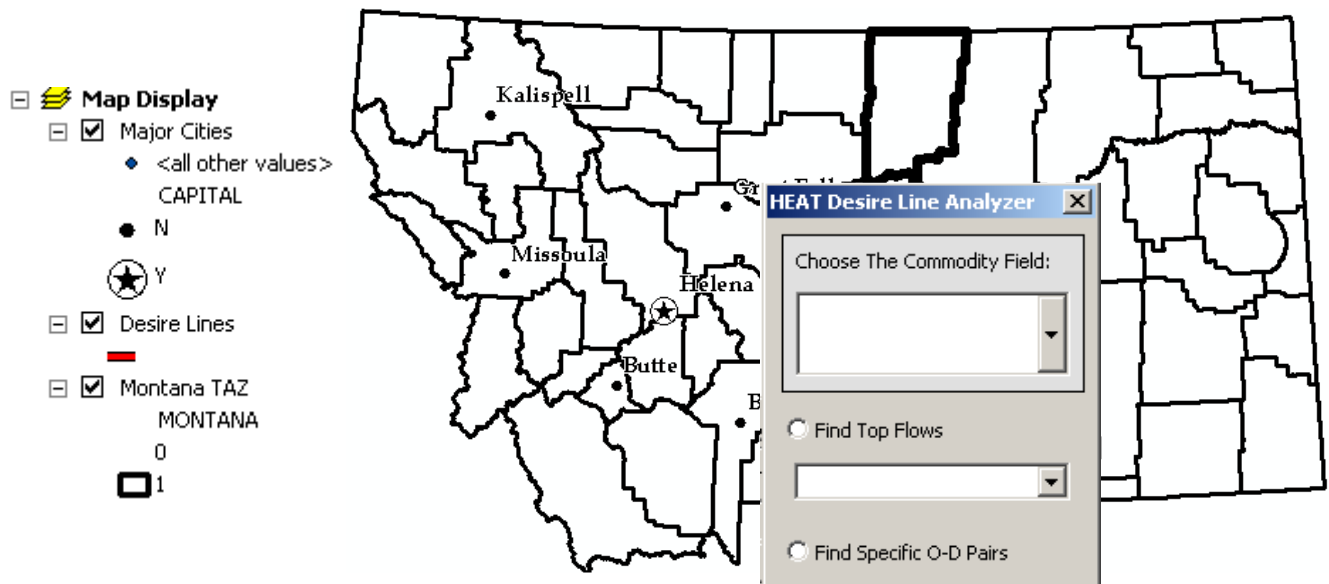
This tool enables you to utilize the origin/destination travel information to draw "desire lines" to show the volume of trips between TAZs (counties) of major commodities & autos. This tool allows you to query the commodity flows to see, for example, the top 10 agriculture commodity flows (by origin and destination) within Montana,

Process:

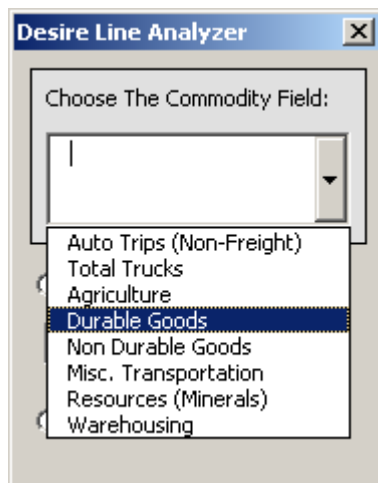
1. Click the arrow to the right of **HEAT Tools** on the Custom Built Toolbar and Click **Desire Lines Tool**.



- Three GIS layers will be added to the TOC and Map View: Major Cities, Desire Lines, and Montana TAZ. In the meanwhile, a dialog form will be presented for you to specify the commodity type and flow type.

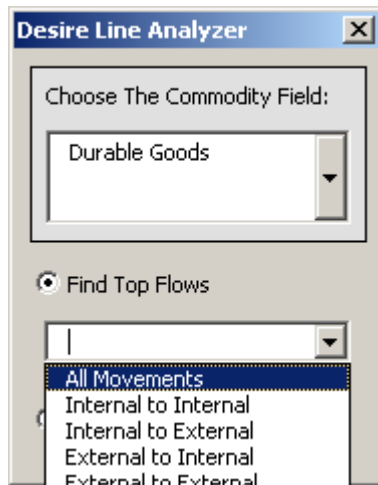


- Click the arrow to the right of the commodity field box to get a dropdown list of all commodity types. Click and choose one of the commodity types.

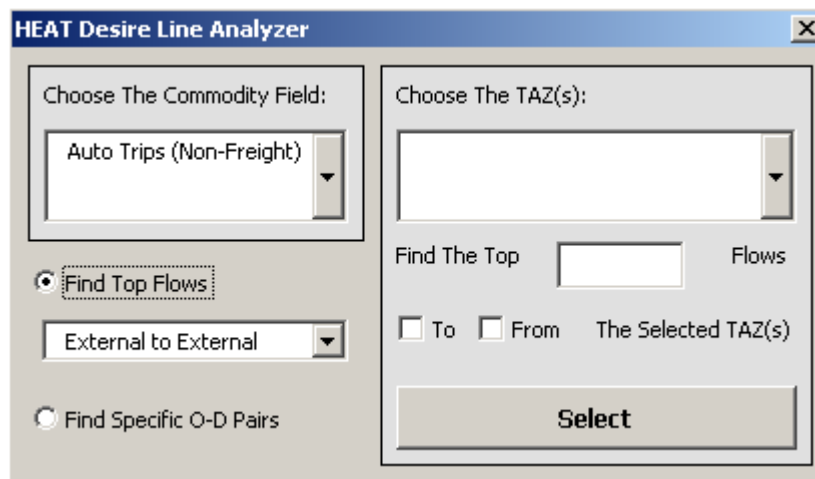


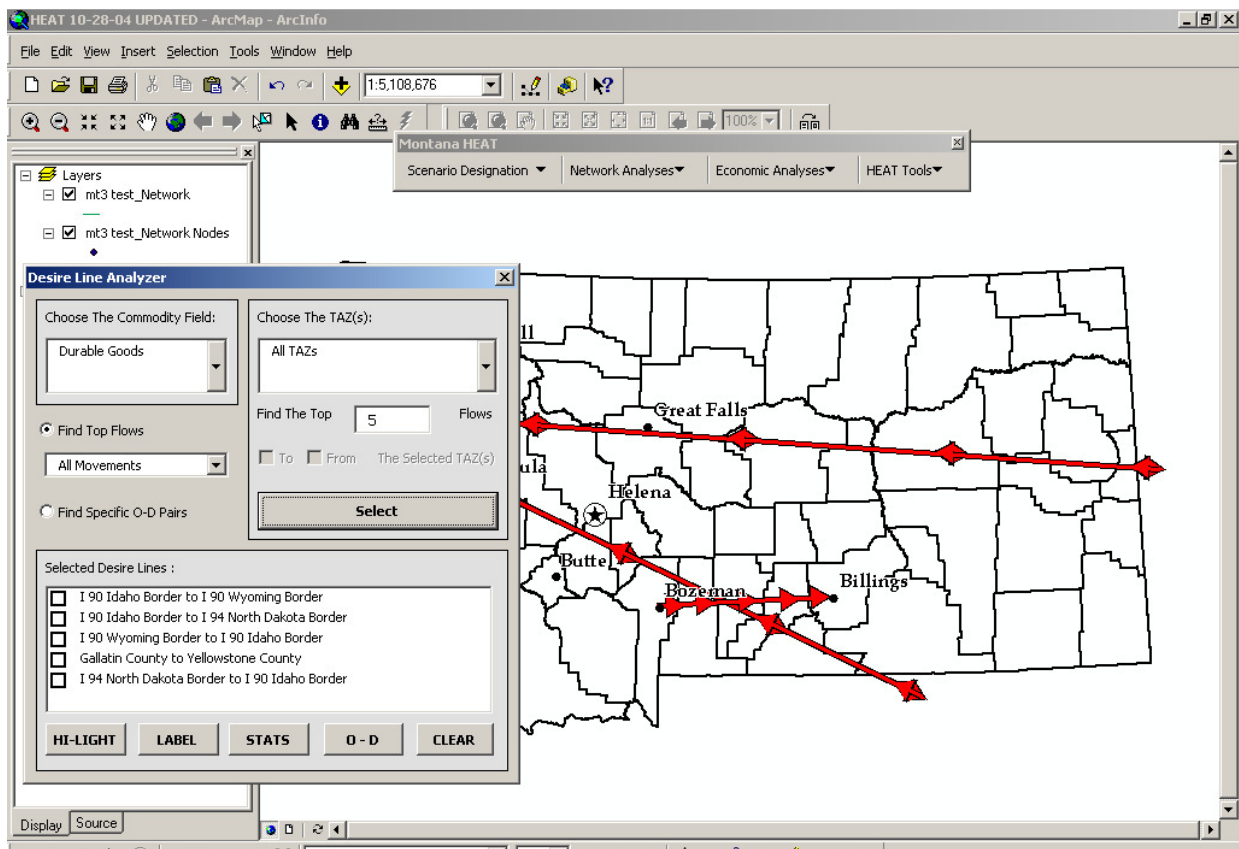
- Choose one of the two option buttons: **Find Top Flows** or **Find Specific O-D Pairs**.
- Click the arrow to the right of the empty dropdown list and select one of the movement types:

- all movements
- internal to internal
- internal to external
- external to internal
- external to external

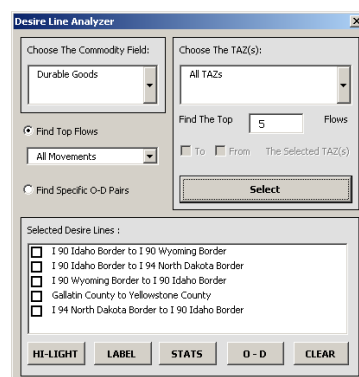


6. If you have chosen **Find Top Flows** in step 4, you will be presented with the following form, where you will choose TAZ(s), specify the number and direction of top flows.

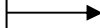




7. In the above example, Durable Goods is chosen as the commodity for All Movements, All Tabs. The Top 5 of these O-D flows is selected and displayed on the map.



*Check off the flows
you wish to view*



Desire Lines Analyzer Buttons:

- **HI-LIGHT** - This hi-lights the flows that have been selected
- **LABEL** - This will label the actual number of flows
- **STATS** - Provides some basic statistics on the Desire Lines chosen
- **O - D** - Shows the internal/external O-D breakdowns
- **CLEAR** - Resets the desire lines

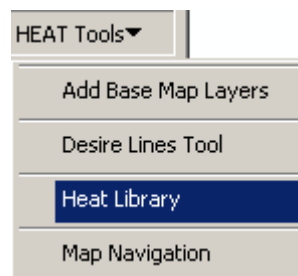
7.3 Library

Purpose:

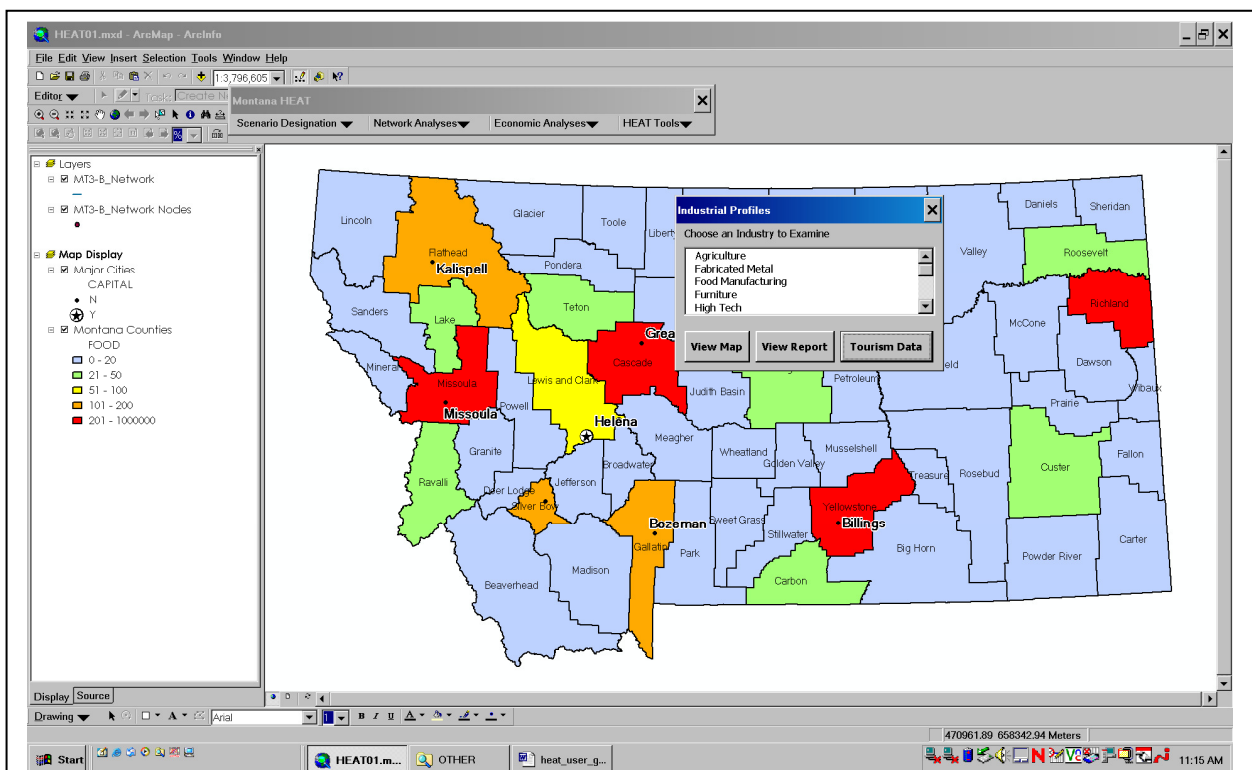
The **HEAT Library** serves as a way to view background information on industrial profiles and tourism data, and map industry concentrations at the county level.

Process:

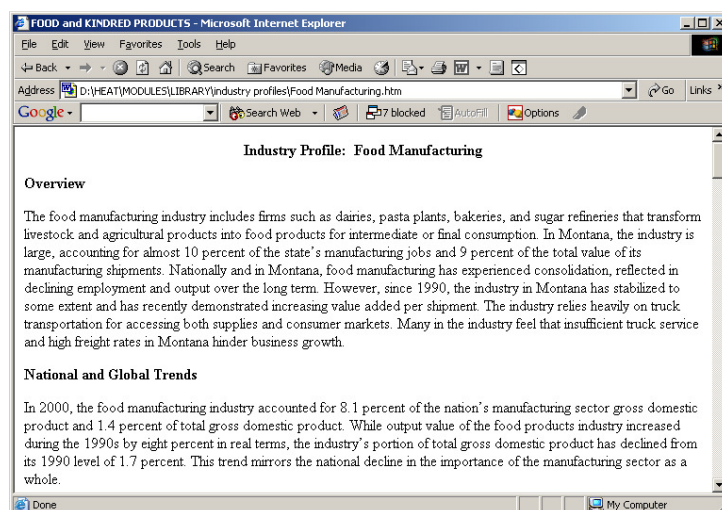
1. Open the Library by going to **HEAT Tools** and then **Library**.



2. Like the Desire Lines Tool, a new map frame will be added and a county shapefile is added which display a colored map showing the various levels of employment for different industries.



3. Choose an industry from the list and then hit **View Map** to see the changes.
4. Hit **View Report** to see a brief write up (in HTML format) on the industry as it exists in Montana.



5. Choose the **Tourism Data** button to view an excel spreadsheet on MT visitation at the regional level, with county-level employment and population to perform county allocations.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Nonresident Visitation to Montana																
2	Institute for Tourism & Recreation Research																
3																	
4	Spring 2001																
5	Visitor Groups	579300				ANNUAL TOTALS											
6	Avg group size	1.07				Visitor Groups	4080829										
7	# of nights in MT	3.04				Visitor Days	36,642,028										
8	Visitor Days	3,469,312															
9																	
10	% of Overnight Stays by region	Visitor Days by region				Visitor Days by region											
11	Glacier	29%	1,006,100			Glacier	10,981,704										
12	Custer	25%	867,328			Custer	6,674,341										
13	Yellowstone	21%	728,555			Yellowstone	10,266,957										
14	Gold West	11%	381,624			Gold West	4,095,774										
15	Russell	10%	346,931			Russell	3,489,298										
16	Missouri	4%	139,772			Missouri	1,133,954										
17		100%				total	36,642,028										
18																	
19	Summer 2001																
20	Visitor Groups	2267140															
21	Avg group size	2.5															
22	# of nights in MT	4.2															
23	Visitor Days	23,804,970															
24																	
25	% of Overnight Stays by region	Visitor Days by region															
26	Glacier	33%	7,855,640														
27	Custer	14%	3,332,696														
28	Yellowstone	30%	7,141,491														
29	Gold West	11%	2,618,547														
30	Russell	9%	2,142,447														
31	Missouri	3%	714,149														
32		100%															
33																	
34	Summary Info / Glacier Country / Gold West Country / Russell Country / Yellowstone Country / Missouri River Country / Custer Country / MDT Districts /																

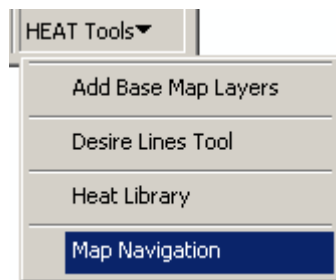
7.4 Navigation Tool

Purpose:

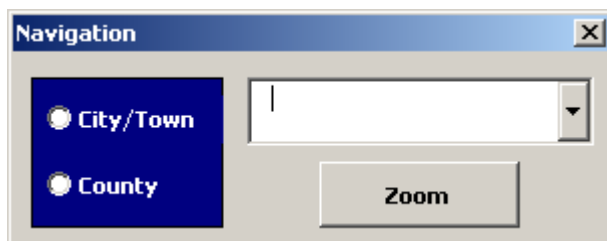
This tool helps you to move around the map display area and let you easily view a specific location. The drop-down menu contains a predefined list of geographic categories to which you can zoom.

Process:

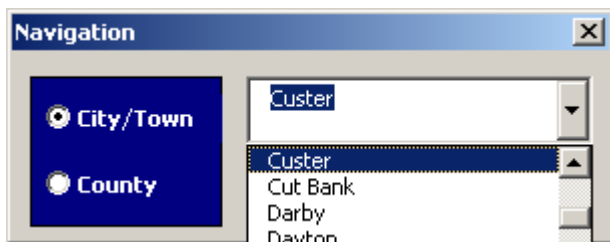
- 1) Click the arrow to the right of **HEAT Tool** on the Custom Built Toolbar and Click Map **Navigation**.



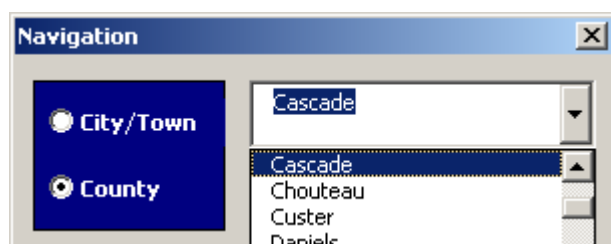
- 2) You will be presented with the following form. Select one of the two options: City/Town or County by clicking one of the option buttons.



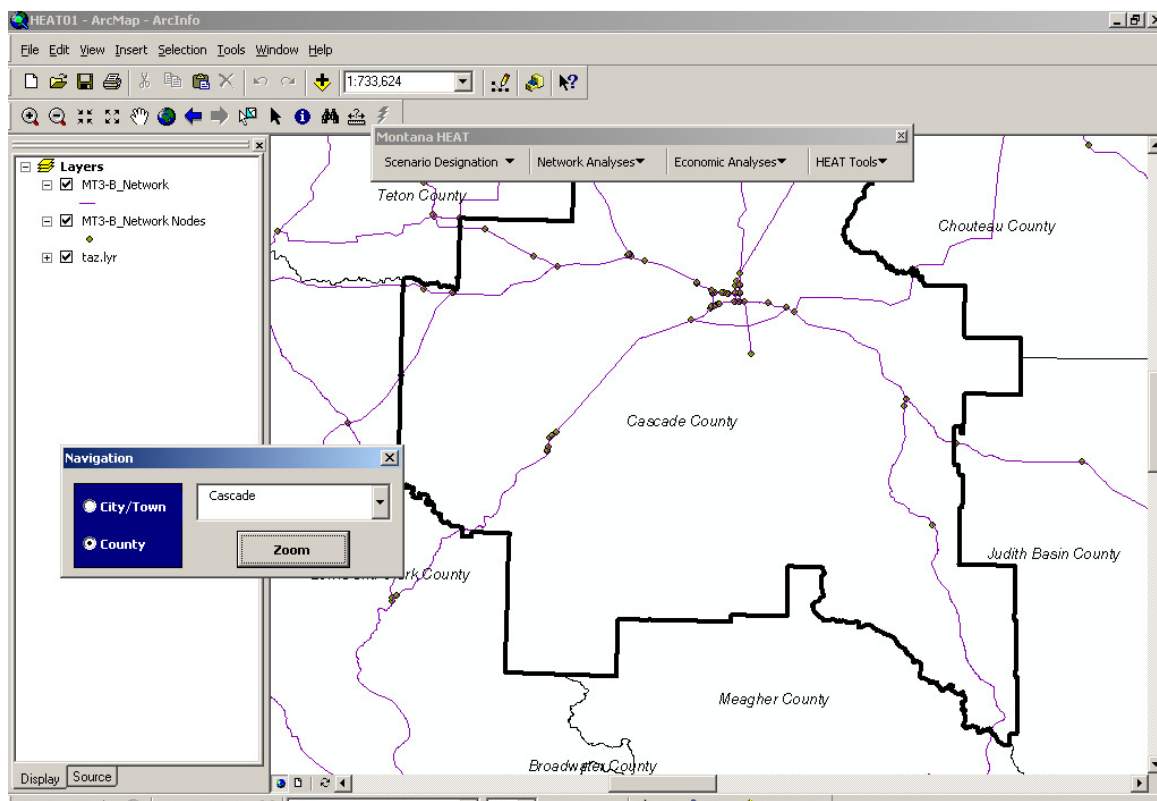
- If you select the **City/Town** option, a GIS layer called "Places.lyr" will be added to the TOC and the map view. The text box drop down list will be populated with all Cities/Towns in Montana, sorted in alphabetical order. Click the down arrow to the right of the dropdown list and select any City/Town from the list.



- If you select the **County** option, a GIS layer called “mt_taz_sp.lyr” will be added to the TOC and the map view. The drop down list will be populated with all counties in Montana, sorted in alphabetical order. Click the down arrow to the right of the dropdown list and select any county.



- 3) Click the **Zoom** button, your map view will be zoomed to the selected City/Town or County.



Appendix A: List of Internal and External Regions

INTERNAL	EXTERNAL
Beaverhead County	E Reserve Hwy
Big Horn County	Hwy 314
Blaine County	Hwy 327
Broadwater County	I 15 Canada Border
Carbon County	I 15 Idaho Border
Carter County	I 90 Idaho Border
Cascade County	I 90 Wyoming Border
Chouteau County	I 94 North Dakota Border
Custer County	Main St
Daniels County	Montana Highway 200
Dawson County	Montana Highway 87 N
Deer Lodge County	N Entrance Rd
Fallon County	State Hwy 13
Fergus County	State Hwy 16 N
Flathead County	State Hwy 191
Gallatin County	State Hwy 200
Garfield County	State Hwy 23
Glacier County	State Hwy 24
Golden Valley County	State Hwy 241
Granite County	State Hwy 59
Hill County	State Hwy 72
Jefferson County	US Hwy 12 Idaho Border
Judith Basin County	US Hwy 12 North Dakota Border
Lake County	US Hwy 2 Idaho Border
Lewis and Clark County	US Hwy 2 North Dakota Border
Liberty County	US Hwy 20
Lincoln County	US Hwy 212 South
Madison County	US Hwy 212 Southwest
McCone County	US Hwy 310
Meagher County	US Hwy 89 W
Mineral County	US Hwy 93 Canada Border
Missoula County	US Hwy 93 Idaho Border
Musselshell County	Wild Horse Trl
Park County	Yellowstone Park
Petroleum County	
Phillips County	
Pondera County	
Powder River County	
Powell County	
Prairie County	
Ravalli County	
Richland County	
Roosevelt County	
Rosebud County	
Sanders County	
Sheridan County	
Silver Bow County	

Stillwater County	
Sweet Grass County	
Teton County	
Toole County	
Treasure County	
Valley County	
Wheatland County	
Wibaux County	
Yellowstone County	

Appendix B: HEAT NOBUILD Base Network – Data Dictionary

Attributes:

OBJECTID – A unique id given to each record. This is automatically generated for ESRI Geodatabase feature classes.

LENGTH – The length of the road segment in miles.

FIRST_NAME – The name of the road segment.

PAVEMENT – Pavement Condition

1. Paved
2. Unpaved

FC – Functional Class

- 1 = Rural Interstate
- 2 = Rural Major Arterial
- 6 = Rural Minor Arterial
- 7 = Rural Major Collector
- 11 = Urban Interstate
- 12 = Urban Major Arterial
- 14 = Urban Minor Arterial
- 16 = Urban Major Collector
- 98-100 = Centroid Connector

AT_ – Area Type

1. Rural Area
2. Small Town
3. Large Town/City

TERRAIN – Terrain Type

1. Level/Plains
2. Rolling Hills
3. Mountainous

LANES – Number of Lanes

- 2 = 2 Lanes
- 4 = 4 Lanes
- 6 = 6 Lanes
- 8 = 8 Lanes

DIVUNDIV – Divided or Undivided Road

1. Divided
2. Undivided

CAPACITY – Roadway Vehicle Capacity

NEW – New Road (Added by user)

0 = Existing

1 = New

TABLESPEED – Field used in speed calculation look-up

OSPEED – Override speed that is defined by user. This value will take the place of the calculate speed if entered.

USERSPEED - Field used in speed calculation look-up

CCW – A weight field used for centroid connectors

SCENARIO – Scenario Value

NHPN – National Highway Planning Network roads

0 = Non-NHPN

1 = NHPN

CENTROID – Centroid Connectors

0 = No

1 = Yes

DEFAULTS – Roads that have default values calculated in tool

0 = No

1 = Yes

D_flds - Lists fields that are calculated as default values in tool

EXISTING – Existing Roads

0 = No

1 = Yes

SELLINK – Select links which are coded in the tool for scenarios

0 = No

1 = Yes

INCOUNTY – The county that the road is in

SCENFLAG – Scenario roads

0 = Not in scenario

1 = In scenario

SPEED - Field used in speed calculation look-up

FINALSPEED – The calculated speed that is used

TRAVELTIME – Road travel time in minutes

TYPE2 = Type 2 classification of roads

1. Super2
2. Improved2
3. Post WWII
4. Pre WWII

CCTAG – The centroid connector ID

ID – A unique ID for network roads